THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Appellants:	Durand, et al.
Appl. No.:	10/595,618
Conf. No.:	3622
Filed:	May 1, 2006
Title:	CONTAINER FOR PRODUCT WITH LESS PACKAGING MATERIAL
Art Unit:	1794
Examiner:	Michael B. Nelson
Docket No.:	3712036-00915

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

APPELLANTS' APPEAL BRIEF

Sir:

Appellants submit this Appeal Brief in support of the Notice of Appeal filed on August 16, 2010. This Appeal is taken from the final Office Action dated July 15, 2010.

I. REAL PARTY IN INTEREST

The real party in interest for the above-identified patent application on Appeal is Nestle Waters Management & Technology by virtue of an Assignment dated October 25, 2006 and recorded at reel 018437, frame 0030 in the United States Patent and Trademark Office.

II. RELATED APPEALS AND INTERFERENCES

Appellants' legal representative and the Assignee of the above-identified patent application do not know of any prior or pending appeals, interferences or judicial proceedings which may be related to, directly affect or be directly affected by or have a bearing on the Board's decision with respect to the above-identified Appeal.

III. STATUS OF CLAIMS

Claims 1, 3 and 5-24 are pending in the above-identified patent application. Claims 2 and 4 were previously canceled without prejudice or disclaimer. Claims 1, 3 and 5-24 stand rejected. Therefore, Claims 1, 3 and 5-24 are being appealed in this Brief. A copy of the appealed claims is included in the Claims Appendix.

IV. STATUS OF AMENDMENTS

A non-final Office Action was mailed on February 3, 2010, in which the Examiner rejected Claims 6-16 under 35 U.S.C. §112, second paragraph, and Claims 1, 3 and 5-24 under 35 U.S.C. §103. Appellants filed a Response to the non-final Office Action on June 21, 2010, in which Appellants argued against the indefinite and obviousness rejections. A final Office Action was mailed on July 15, 2010, in which the Examiner withdrew the rejection of Claims 6-16 under 35 U.S.C. §112, second paragraph, and maintained the rejections of Claims 1, 3 and 5-24 under 35 U.S.C. §103. Appellants filed a Notice of Appeal on August 16, 2010. Copies of the non-final Office Action and final Office Action are included in the Evidence Appendix as Exhibits A and B, respectively.

V. SUMMARY OF CLAIMED SUBJECT MATTER

A summary of the invention by way of reference to the specification (WO 2005/047120) and/or figures for each of the independent claims is provided as follows:

Independent Claim 1 is directed to a container comprising a body formed by walls and a bottom (page 1, line 31-page 2, line 4), the body having as its greatest diameter a dimension d_1 and a neck with an internal diameter d_2 (page 1, line 31-page 2, line 4), said container being made from a semi-crystalline PET (page 1, line 31-page 2, line 4), the body of said container comprising at its bottom at least three feet spaced from each other and being integral with said body (page 1, line 31-page 2, line 4), wherein the ratio weight of the walls to the weight of the bottom is between 3 and 4 (page 1, line 31-page 2, line 4) and the ratio volume, in ml, of the body of the container per gram of PET of the body is between 80 and 120 (page 1, line 31-page 2, line 4), and wherein the walls of the body have a thickness of less than 100 μm (page 3, lines 1-9); the part of the bottom between the feet has a thickness between 100 and 200 μm (page 3, lines 1-9); and each foot has a thickness between 50 and 150 μm (page 3, lines 1-9).

Independent Claim 6 is directed to a packaging assembly comprising a container comprising a body formed by walls and a body (page 1, line 31-page 2, line 4), having as its greatest diameter a dimension d_1 and a neck with an internal diameter d_2 (page 1, line 31-page 2, line 4), said container being made from a semi-crystalline PET (page 1, line 31-page 2, line 4), the body of said container comprising at its bottom at least three feet spaced from each other and being integral with said body (page 1, line 31-page 2, line 4), wherein the ratio weight of the walls to the weight of the bottom is between 3 and 4 (page 1, line 31-page 2, line 4) and the ratio volume, in ml, of the body of the container per gram of PET of the body is between 80 and 120 (page 1, line 31-page 2, line 4), and wherein: the walls of the body have a thickness of less than 100 μm (page 3, lines 1-9); the part of the bottom between the feet has a thickness between 100 and 200 μm (page 3, lines 1-9); and each foot has a thickness between 50 and 150 μm page 4, paragraphs 9-10); a product in the container (page 3, lines 11-27); and closing means for closing off or distributing the product from the neck (page 3, lines 11-27; page 4, lines 23-34).

Although specification citations are given in accordance with C.F.R. 1.192(c), these reference numerals and citations are merely examples of where support may be found in the specification for the terms used in this section of the Brief. There is no intention to suggest in

any way that the terms of the claims are limited to the examples in the specification. As demonstrated by the references numerals and citations, the claims are fully supported by the specification as required by law. However, it is improper under the law to read limitations from the specification into the claims. Pointing out specification support for the claim terminology as is done here to comply with rule 1.192(c) does not in any way limit the scope of the claims to those examples from which they find support. Nor does this exercise provide a mechanism for circumventing the law precluding reading limitations into the claims from the specification. In short, the references numerals and specification citations are not to be construed as claim limitations or in any way used to limit the scope of the claims.

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

1. Claims 1, 3, 5-11, 13-19 and 21-24 are rejected under 35 U.S.C. §103(a) as being unpatentable over JP 2001-0122237 to Hideaki et al. ("*Hideaki*") in view of U.S. Patent No. 5,614,148 to Beck et al. ("*Beck*") and in view of U.S. Publication No. 2003/0031814 to Hutchinson et al. ("*Hutchinson*"). Copies of *Hideaki*, *Beck*, and *Hutchinson* are included in the Evidence Appendix as Exhibits C, D and E, respectively.

2. Claims 12 and 20 are rejected under 35 U.S.C. §103(a) as being unpatentable over *Hideaki* in view of *Beck* and *Hutchinson*, as applied to Claims 4 and 6 above, and further in view of U.S. Publication No. 2002/0185212 to Schaupp et al. ("*Schaupp*"). A copy of *Schaupp* is attached herewith as Exhibit F in the Evidence Appendix.

VII. ARGUMENT

A. LEGAL STANDARDS

Obviousness under 35 U.S.C. §103

The Federal Circuit has held that the legal determination of an obviousness rejection under 35 U.S.C. § 103 is:

> whether the claimed invention as a whole would have been obvious to a person of ordinary skill in the art at the time the invention was made...The foundational facts for the prima facie case of obviousness are: (1) the scope and content of the prior art; (2) the difference between the prior art and the claimed invention; and (3) the level of ordinary skill in the art...Moreover, objective indicia such as commercial success and long felt need are relevant to the determination of obviousness...Thus, each obviousness determination rests on its own facts.

In re Mayne, 41 U.S.P.Q. 2d 1451, 1453 (Fed. Cir. 1997).

In making this determination, the Patent Office has the initial burden of proving a *prima facie* case of obviousness. *In re Rijckaert*, 9 F.3d 1531, 1532, 28 U.S.P.Q. 2d 1955, 1956 (Fed. Cir. 1993). This burden may only be overcome "by showing some objective teaching in the prior art or that knowledge generally available to one of ordinary skill in the art would lead that individual to combine the relevant teachings." *In re Fine*, 837 F.2d 1071, 1074, 5 U.S.P.Q. 2d 1596, 1598 (Fed. Cir. 1988). "If the examination at the initial stage does not produce a prima facie case of unpatentability, then without more the applicant is entitled to grant of the patent." *In re Oetiker*, 24 U.S.P.Q. 2d 1443, 1444 (Fed. Cir. 1992).

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the reference or references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. *In re Fine*, 837 F.2d 1071, 5, U.S.P.Q.2d 1596 (Fed. Cir. 1988). Second, there must be a reasonable expectation of success. *In re Merck & Co., Inc.*, 800 F.2d 1091, 231 U.S.P.Q. 375 (Fed. Cir. 1986). Finally, all of the claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 U.S.P.Q., 580 (CCPA 1974).

Further, the Federal Circuit has held that it is "impermissible to use the claimed invention as an instruction manual or 'template' to piece together the teachings of the prior art so that the

claimed invention is rendered obvious." *In re Fritch*, 23 U.S.P.Q.2d 1780, 1784 (Fed. Cir. 1992). "One cannot use hindsight reconstruction to pick and choose among isolated disclosures in the prior art to deprecate the claimed invention." *In re Fine*, 837 F.2d 1071 (Fed. Cir. 1988).

Moreover, the Federal Circuit has held that "obvious to try" is not the proper standard under 35 U.S.C. §103. *Ex parte Goldgaber*, 41 U.S.P.Q.2d 1172, 1177 (Fed. Cir. 1996). "An-obvious-to-try situation exists when a general disclosure may pique the scientist curiosity, such that further investigation might be done as a result of the disclosure, but the disclosure itself does not contain a sufficient teaching of how to obtain the desired result, or that the claimed result would be obtained if certain directions were pursued." *In re Eli Lilly and Co.*, 14 U.S.P.Q.2d 1741, 1743 (Fed. Cir. 1990).

Of course, references must be considered as a whole and those portions teaching against or away from the claimed invention must be considered. *Bausch & Lomb, Inc. v. Barnes-Hind/Hydrocurve Inc.*, 796 F.2d 443 (Fed. Cir. 1986). "A prior art reference may be considered to teach away when a person of ordinary skill, upon reading the reference would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the Applicant." *Monarch Knitting Machinery Corp. v. Fukuhara Industrial Trading Co., Ltd.*, 139 F.3d 1009 (Fed. Cir. 1998), quoting, *In re Gurley*, 27 F.3d 551 (Fed. Cir. 1994).

B. THE CLAIMED INVENTION

Independent Claim 1 is directed to a container comprising a body formed by walls and a bottom. The body has, as its greatest diameter, a dimension d_1 and a neck with an internal diameter d_2. The container is made from a semi-crystalline PET. The body of the container includes at its bottom at least three feet spaced from each other that are integral with the body. The ratio weight of the walls to the weight of the bottom is between 3 and 4, and the ratio volume, in ml, of the body of the container per gram of PET of the body is between 80 and 120. The walls of the body have a thickness of less than 100 μm. The part of the bottom between the feet has a thickness between 100 and 200 μm, and each foot has a thickness between 50 and 150 μm.

Independent Claim 6 is directed to a packaging assembly including a container having a body formed by walls. The body has, as its greatest diameter, a dimension d_1 and a neck with an internal diameter d_2. The container is made from a semi-crystalline PET. The body of the container includes at its bottom at least three feet spaced from each other that are integral with the body. The ratio weight of the walls to the weight of the bottom is between 3 and 4, and the ratio volume, in ml, of the body of the container per gram of PET of the body is between 80 and 120. The walls of the body have a thickness of less than 100 μm. The part of the bottom between the feet has a thickness between 100 and 200 μm. Each foot has a thickness between 50 and 150 μm. The packaging assembly further includes a product in the container and closing means for closing off or distributing the product from the neck.

C. THE REJECTION OF CLAIMS 1, 3, 5-11, 13-19 AND 21-24 UNDER 35 U.S.C. §103(a) SHOULD BE REVERSED BECAUSE THE EXAMINER HAS FAILED TO ESTABLISH A *PRIMA FACIE* CASE OF OBVIOUSNESS

Appellants respectfully submit that the obviousness rejection of Claims 1, 3, 5-11, 13-19 and 21-24 should be reversed because the Examiner has failed to establish a *prima facie* case of obviousness. In the final Office Action, the Examiner asserts that the combination of *Hideaki, Beck* and *Hutchinson* renders the claimed subject matter obvious. See, final Office Action, pages 3-7. However, the Examiner has failed to establish a *prima facie* case of obviousness because the cited references fail to disclose each and every element of the present claims. Further, there exists no reason why the skilled artisan would have combined *Hideaki, Beck* and *Hutchinson* to arrive at the presently claimed subject matter.

1. The Presently Claimed Containers and Advantages Provided by Same

Independent Claims 1 and 6 recite, in part, a container comprising a body formed by walls and a bottom, the body having as its greatest diameter a dimension d_1 and a neck with an internal diameter d_2, said container being made from a semi-crystalline PET, the body of said container comprising at its bottom at least three feet spaced from each other and being integral with said body, wherein the ratio weight of the walls to the weight of the bottom is between 3

and 4 and the ratio volume, in ml, of the body of the container per gram of PET of the body is between 80 and 120, and wherein the walls of the body have a thickness of less than 100 μm; the part of the bottom between the feet has a thickness between 100 and 200 μm; and each foot has a thickness between 50 and 150 μm.

Conventional beverage containers have attempted to reduce the amount of plastic material used simply by reducing the weight of the bottom portion. See, specification (WO 2005/047120), page 1, lines 8-22. However, prior art solutions such as petaloid bottoms are still too thick and use too much plastic material for the volume of product held by the container. See, specification, page 1, lines 8-22. Therefore, the present claims provide a container made from a semi-crystalline PET, the body of said container comprising at its bottom portion at least three feet spaced from each other and being integral with said body, wherein the ratio weight of the walls to the weight of the bottom is between 3 and 4 and the ratio volume, in ml, of the body of the container per gram of PET of the body is between 80 and 120, and wherein the walls of the body have a thickness of less than 100 μm; the part of the bottom between the feet has a thickness between 100 and 200 μm; and each foot has a thickness between 50 and 150 μm. The ratio weight of the walls to the weight of the bottom is between 3 and 4, and the ratio volume, in ml, of the body of the container per gram of PET of the body is between 80 and 120. The part of the bottom between the feet has a thickness between 100 and 200 μm, and each foot has a thickness between 50 and 150 μm. The claimed design results in a reduction of nearly 50% in the amount of material required per volume of product as compared with prior art containers. See, specification, page 12, lines 20-36. In contrast, the cited references are deficient with respect to the present claims.

According to a feature of the presently claimed containers, the ratio weight of the walls to the weight of the bottom is between 3 and 4. There exists no product on the market, nor in the cited documents, that discloses this ratio according to the present claims. In fact, none of the cited documents disclose or even suggest that the weight ratio of the walls to the bottom has any effect on the amount of plastic material required for a given beverage volume. Furthermore, when forming the container by blow-molding a plastic material such as PET, it would not have been evident to reach the above mentioned weight ratio while simultaneously maintaining a good structural integrity of the container.

2. The Cited References Fail to Disclose or Suggest Each and Every Element of the Present Claims

Appellants respectfully submit that the cited references fail to disclose or suggest a container wherein the ratio weight of the walls to the weight of the bottom is between 3 and 4 as required, in part, by independent Claims 1 and 6. The Examiner even admits that *Hideaki* fails to disclose a weight ratio of the walls to the bottom in the claimed range. See, final Office Action, page 5, lines 11-12. Instead, *Hideaki* discloses an ultrathin-walled bottle having barrel walls with thicknesses between 20 and 50 μm. See, *Hideaki*, paragraph 10. *Hideaki* does not specifically disclose a weight ratio of the weight of the wall section compared to the weight of the bottom section. Moreover, *Hideaki* fails to disclose or suggest that the ratio of the weight of the walls to the weight of the bottom of the container has any effect on the amount of plastic material required per volume of beverage stored therein. As such, *Hideaki* fails to teach the advantages and benefits of having a container with the weight ratio of the weight of the walls to the weight of the bottom between 3 and 4 in accordance with the present claims.

Beck teaches a blow-molded plastic container having a petaloid bottom. See, *Beck*, Abstract, lines 1-5; column 1, lines 63-67; Fig. 5. *Beck* is entirely directed to reducing the weight of its petaloid bottom by placing a reinforcing ring in the feet while reducing the thickness of the area between the feet. See, *Beck*, column 7, lines 46-53. Like *Hideaki*, *Beck* does not specifically disclose a weight ratio of its walls compared to its bottom and fails to even suggest that such a ratio has any effect on the total amount of plastic material required per volume of beverage stored therein. Instead, *Beck* is concerned only with the distribution of material in and resulting weight of its petaloid base and fails to even mention the weight of its sidewalls. See, *Beck*, column 3, lines 15-15; column 7, lines 1-59; Figs. 3-5. As described in the specification, prior art containers having petaloid bottoms do not consider the amount of material necessary to form the container for the volume of the product filled in the container. See, specification, page 1, lines 8-22. Therefore, *Beck* fails to teach or suggest optimizing the weight ratio of the walls to the bottom of the container.

Further, even if the wall thicknesses of the bottom and top portions of *Hideaki* and/or *Beck* are similar, the portion of *Beck* relied on by the Examiner (e.g., Fig. 1) is not necessarily drawn to scale and does not indicate that the height ratio of the walls to the bottom is such that

the weight ratio is between 3 and 4. See, *Beck*, Fig. 1. Furthermore, the Examiner bases his conclusion of obviousness merely on the height ratio of the sidewalls to the walls of the bottom portion of *Beck* and fails to account for the weight of the feet or the valleys between the feet in the bottom of *Beck*. Nowhere do *Beck* or *Hideaki* disclose the weight ratio of the walls to that of the bottom of the container. Thus, the cited references fail to disclose or suggest a container wherein the ratio weight of the walls to the weight of the bottom is between 3 and 4 in accordance with the present claims.

Hutchinson also fails to disclose a weight ratio of its walls compared to its bottom. Moreover, *Hutchinson* fails to teach that such a ratio has any effect on the total amount of plastic material required per volume of beverage stored therein. Instead, *Hutchinson* is entirely directed to a plastic bottle having a crystalline neck and a semi-crystalline or amorphous body to enhance the physical properties of the bottle. See, *Hutchinson*, Title; Abstract; page 1, paragraphs 7-9. Thus, *Hutchinson* fails to teach or suggest optimizing the ratio of the weight of the walls to the weight of the bottom of its container to achieve the claimed weight ratio. As such, even if combinable, *Hideaki*, *Beck* and *Hutchinson* fail to disclose or suggest a container wherein the ratio weight of the walls to the weight of the bottom is between 3 and 4.

In addition, the cited references also fail to disclose or suggest a container wherein the ratio volume, in ml, of the body of the container per gram of PET of the body is between 80 and 120 as recited, in part, by Claims 1 and 6. Again, the Examiner even admits that *Hideaki* fails to disclose that its volume per gram of PET ratio is within the claimed range. See, final Office Action, page 5, lines 3-5, 11-12 and 16-17. *Hideaki* is entirely directed to a bottle having ultra-thin ***side*** walls in the barrel part so that the walls can be pushed into the shoulder part at the time of disposal and thereby allow for a larger amount of bottles to be transported and stockpiled for recycling. See, *Hideaki*, page 1, paragraphs 2-3; page 2, paragraphs 5 and 7. *Hideaki* does not specifically disclose the total weight or volume of its bottle. *Hideaki* further fails to disclose the height or density of its side walls or bottom walls. As such, one of ordinary skill in the art could not determine the overall weight of *Hideaki*'s bottle. Furthermore, although *Hideaki* teaches the use of ultra-thin ***side*** walls for compression into the shoulder and eventual recycling, *Hideaki* expressly discloses that the overall container cannot be made too thin or light because the walls of the bottom part must be thicker to support the load of the content in the bottle. See, *Hideaki*, pages 5-6, paragraph 10. As such, one of ordinary skill in the art would understand that *Hideaki*

fails to teach optimizing the total amount of plastic used per volume of the container and instead is concerned only with decreasing the thickness of its side walls for disposal purposes.

Beck teaches a blow-molded plastic container having a petaloid bottom. See, *Beck*, Abstract, lines 1-5; column 1, lines 63-67; Fig. 5. *Beck* is entirely directed to reducing the weight of its petaloid bottom by placing a reinforcing ring in the feet while reducing the thickness of the area between the feet. See, *Beck*, column 7, lines 46-53. However, *Beck* specifically acknowledges that simply decreasing the weight of the bottom portion of the bottle without also redesigning the bottle is an inadequate method for achieving a reduced-weight bottle with sufficient structural integrity. See, *Beck*, column 7, lines 24-45. Therefore, *Beck* teaches that reducing the weight of its bottle is not a matter of mere routine experimentation and instead teaches that a unique design must be used to achieve a reduced weight while adequately supporting the contents of the bottle. As such, one of ordinary skill in the art would understand that the claimed ratio of the volume of the body per gram of PET used would not have been obvious at the time of the invention.

In fact, one of ordinary skill in the art would understand that a container as disclosed by *Beck,* or including a bottom portion as disclosed by *Beck,* cannot have both weight and volume to weight ratios within the claimed ranges. For example, *Beck* teaches that its bottle is designed for a volume of 2 liters (2000 ml). *Beck* further teaches that its petaloid base has a weight of 13.5 g. If the weight ratio of the walls to the bottom is in the claimed range, the walls would weigh between 40.5 g (13.5 g x 3) and 54.0 g (13.5 g x 4). The total weight of the bottle of *Beck* would then be 54.0-67.5 g. Thus, the volume to weight ratio of the bottle of *Beck* would be 29.6-37.0 ml per g of plastic, which is much lower than the claimed range. As such, *Beck* fails to teach or suggest a container which simultaneously achieves the weight and volume to weight ratios of the present claims. For the same reasons, if the bottle of *Hideaki* were modified to include the base of *Beck*, the resulting container cannot have weight and volume to weight ratios within the claimed range, since the weight of the base of *Beck* per volume of the modified container would remain the same (and therefore the weight of the walls compared to the overall volume of the modified container would remain the same).

Hutchinson also fails to disclose a volume ratio of its body compared to the amount of plastic used to form its bottle. Instead, *Hutchinson* is entirely directed to a plastic bottle having a crystalline neck and a semi-crystalline or amorphous body to enhance the physical properties of

the bottle. See, *Hutchinson*, Title; Abstract; page 1, paragraphs 7-9. Therefore, *Hutchinson* fails to suggest optimizing the design of the bottle to achieve the claimed volume to weight ratio, and, even if combinable, *Hideaki*, *Beck* and *Hutchinson* fail to disclose or suggest a container wherein the ratio volume, in ml, of the body of the container per gram of PET of the body is between 80 and 120.

Further, Appellants respectfully submit that, even if the wall thicknesses of *Hideaki* are similar to those of the present claims, the weight of the PET for a given volume varies depending on the crystallinity of the PET. See, specification, page 11, Density/Crystallinity Table. Nowhere does *Hideaki* disclose or suggest the level of crystallinity of its PET. Furthermore, although the Examiner relies on *Hutchinson* for the disclosure of semi-crystalline PET being conventionally used in bottles, even if semi-crystalline PET were used, nowhere does *Hutchinson* disclose a specific crystallinity level. See, *Hutchinson*, page 1, paragraphs 6-9. As such, even if the walls of *Hideaki* have similar thicknesses to those of the present claims and use semi-crystalline PET, the density of the bottle is unknown and not necessarily within the claimed range. Thus, the cited references fail to disclose a container wherein the ratio volume, in ml, of the body of the container per gram of PET of the body is between 80 and 120 as required, in part, by the present claims.

In the final Office Action, the Examiner states that *Hutchinson* "was just used to show it was known to use semi-crystalline PET as a material in blown PET bottles and does not relate to the structural layout of the bottle." See, final Office Action, page 9, lines 18-20. In response, however, Appellants submit that it is improper for the Examiner to consider only select portions of a prior art reference. Instead, Appellants submit that the reference must be considered as a whole, regardless of the reason provided by the Examiner for the citation of the reference. Additionally, the MPEP states that "[a] prior art reference must be considered in its entirety, i.e., as a whole, including portions that would lead away from the claimed invention. *W.L. Gore & Associates, Inc. v. Garlock, Inc.*, 721 F.2d 1540, 220 USPQ 303 (Fed. Cir. 1983), *cert. denied*, 469 U.S. 851 (1984)." See, MPEP, Section 2141.02.

Furthermore, the cited references also fail to disclose or suggest a container wherein the part of the bottom between the feet has a thickness between 100 and 200 μm and each foot has a thickness between 50 and 150 μm as recited, in part, by Claims 1 and 6. The Examiner even admits that *Hideaki* fails to disclose a thickened bottom portion as claimed. See, final Office

Action, page 4, lines 8-9. *Hideaki* teaches a bottle having ultra-thin ***side*** walls in the barrel part so that the walls can be pushed into the shoulder part at the time of disposal and thereby allow for a larger amount of bottles to be transported and stockpiled for recycling. See, *Hideaki*, page 1, paragraphs 2-3; page 2, paragraphs 5 and 7. *Hideaki* does not specifically disclose the thickness of any portions of its bottom part and instead merely discloses that "[s]ince the bottom part 4 will have the load of the content applied to it, its walls should preferably be thicker than the walls of the barrel part 3." See, *Hideaki*, pages 5-6, paragraph 11. However, nowhere does *Hideaki* teach or suggest how thick the walls of the bottom part should be. In fact, *Hideaki* is entirely unconcerned with the specific design of its bottom part and instead is directed to decreasing the thickness of its side walls for disposal purposes. As such, *Hideaki* fails to teach the advantages and benefits of having a container with the claimed thicknesses in the bottom portion.

In contrast to the Examiner's assertion, *Hideaki* does not teach that its shoulder part has an increased thickness to provide added structural support but rather so that the ultra-thin walls may be pushed into the shoulder part at the time of disposal and thereby allow for a larger amount of bottles to be transported and stockpiled for recycling. See, *Hideaki*, page 1, paragraphs 2-3; page 2, paragraphs 5 and 7. Furthermore, the shoulder part of *Hideaki* has a thickness between 200 and 500 μm. See, *Hideaki*, page 5, paragraph 10. Therefore, even if one skilled in the art were attempting to provide added structural support to the bottom of *Hideaki* as suggested by the Examiner, *Hideaki* suggests a thickness between 200 and 500 μm, rather than the claimed 100-200 μm range. As such, *Hideaki* fails to suggest providing a bottom portion having the claimed thicknesses to one of ordinary skill in the art.

Beck discloses that the thickness "A" between its feet is between 0.060 and 0.087 inches (1,524 to 2,210 μm). See, *Beck*, column 7, lines 33-34. *Beck* further discloses that more material is provided in its feet such that the thickness of its feet is between 0.008 and 0.14 inches (203 to 3,556 μm). See, *Beck*, column 7, lines 29-32. These values are both substantially greater than the claimed thickness ranges. Furthermore, *Beck* teaches that merely reducing the weight of a bottom portion of the bottle is insufficient to obtain a structurally sound bottle without the redistribution of the material and the use of its reinforcing ring. See, *Beck*, column 7, lines 21-23. Thus, *Beck* expressly teaches that reducing the thicknesses of distinct portions of the bottom of the bottle while maintaining sufficient structural integrity would not have been a matter of

routine experimentation. In fact, if the bottom portion of *Hideaki* is modified to include the petaloid foot structure of *Beck*, as the Examiner suggests, the bottom portion would have much thicker feet and much thicker portions between the feet. As such, one skilled in the art would have no reason to merely reduce the thicknesses of the feet of *Beck* to arrive at the claimed thickness values.

Hutchinson fails to disclose any thicknesses of a finished container. Instead, the only thicknesses disclosed in *Hutchinson* are for the preform (pre-blow molding) or barrier coating (covering the body of the container). See, *Hutchinson*, page 5, paragraphs 56 and 61. Specifically, *Hutchinson* discloses that the wall of the bottom portion of the preform may have a thickness of 3.2 millimeters; the wall of the neck, a cross-sectional dimension of about 3 millimeters; and the barrier material applied to a thickness of about 0.3 millimeters. See, *Hutchinson*, page 5, paragraph 56. However, *Hutchinson* is entirely unconcerned with the thicknesses of the bottom portion of a finished container and fails to teach or suggest optimizing the design of the bottle to achieve the claimed thicknesses in the finished bottom portion.

As such, Appellants respectfully submit that a container wherein the ratio weight of the walls to the weight of the bottom is between 3 and 4 and the ratio volume, in ml, of the body of the container per gram of PET of the body is between 80 and 120, and wherein: the walls of the body have a thickness of less than 100 μm; the part of the bottom between the feet has a thickness between 100 and 200 μm; and each foot has a thickness between 50 and 150 μm would not have been obvious to one of ordinary skill in the art based on the disclosures of the cited references.

3. The Skilled Artisan Would Have No Reason to Combine The Cited References To Arrive At The Present Claims

Appellants also respectfully submit that the skilled artisan would have no reason to combine the cited references to arrive at the present claims. For example, the Examiner admits that *Hideaki* fails to disclose a weight ratio of the walls to the bottom in the claimed range but nevertheless asserts that one of ordinary skill in the art would merely "have optimized the weight of the wall portion of the container to the bottom portion of the container as part of the general design process for determining the shape and wall thickness of various parts of the container."

See, final Office Action, page 5, lines 12-15. However, the Examiner fails to explain how one skilled in the art would have optimized the weight ratio of the walls to the bottom of the container, and the cited references fail to suggest such optimization. Appellants respectfully submit that one of ordinary skill in the art would understand that optimization of the weight of the bottle is the entire goal of this art, and such optimization cannot be achieved as a matter of routine experimentation merely by reducing the thicknesses of the wall or bottom portions.

In fact, the cited reference of *Beck* demonstrates that optimizing the weight ratio of the walls to the bottom of a plastic beverage container would not have been a matter of mere routine experimentation to one skilled in the art. Table 1 of *Beck* compares the overall bottle size and weight, as well as the thickness of specific wall portions of prior art bottles with its bottle. See, *Beck*, column 6, lines 64-67. The base weight of *Beck*, 13.5g, is less than two of the prior art bottles. See, *Beck*, Table 1. However, in comparing its reduced-weight bottle to another prior art bottle, *Beck* teaches that the prior art preform, although having the same base weight, did not provide adequate structural strength because its thickness D2 at a specific point on the bottom was too thin. See, *Beck*, column 7, lines 16-20. Thus, *Beck* expressly states that "without the redistribution of the material and the reinforcing ring of the present invention, merely reducing weight is insufficient to obtain a structurally sound bottle." See, *Beck*, column 7, lines 21-23. As such, *Beck* discloses that merely decreasing the weight of the bottom portion of the bottle and thus altering the weight ratio of the walls to the bottom is an inadequate technique for obtaining a reduced-weight bottle without also redesigning the bottle. See, *Beck*, column 7, lines 24-45.

Furthermore, Appellants respectfully submit that optimizing the weight ratio of the walls to the bottom would not have been obvious to one skilled in the art because the cited references do not recognize such weight ratio as a result-effective variable. "A particular parameter must first be recognized as a result-effective variable, i.e., a variable which achieves a recognized result, before the determination of the optimum or workable ranges of said variable might be characterized as routine experimentation." See, M.P.E.P. § 2144.05(B) (2009). *Hideaki* is entirely directed to a bottle having ultra-thin walls in the barrel part so that the walls can be pushed into the shoulder part at the time of disposal and thereby allow for a larger amount of bottles to be transported and stockpiled for recycling. See, *Hideaki*, page 1, paragraphs 2-3; page 2, paragraphs 5 and 7. *Beck* is entirely directed to a petaloid design for the base or bottom of a bottle and fails to even discuss the thickness of the walls of the bottle. See, *Beck*, column 1, lines

5-17; column 3, lines 15-25. At no place in the disclosures do either *Hideaki* or *Beck* disclose that the ratio of the weight of the walls to the weight of the bottom portion of the bottle achieves any particular result. Thus, Appellants respectfully submit that one skilled in the art would have no reason to modify or optimize the weight ratio of the walls to the bottom portion of either *Hideaki* or *Beck* to arrive at the present claims.

Further, the present claims recite, in part, wherein the ratio volume, in ml, of the body of the container per gram of PET of the body is between 80 and 120. Appellants respectfully submit that obtaining the claimed ratio volume would not have been obvious as a matter of mere routine experimentation or optimization to one of ordinary skill in the art. For example, as is also discussed previously, *Beck* specifically acknowledges that simply decreasing the weight of the bottom portion of the bottle without also redesigning the bottle is an inadequate method for achieving a reduced-weight bottle with sufficient structural integrity. See, *Beck*, column 7, lines 24-45. Furthermore, although *Hideaki* recognizes that it is desirable to use less resin to achieve equivalent volume containment, *Hideaki* acknowledges that the container cannot be made too thin or light because it must be able to support the load applied to it ("Since the bottom part 4 will have the load of the content applied to it, its walls should preferably be thicker than the walls of the barrel part 3"). See, *Hideaki*, page 6, paragraph 10, lines 3-5. Therefore, Appellants respectfully submit that the cited references fail to disclose or render obvious the claimed ratio of the volume of the body per gram of PET of the body.

Additionally, the Examiner admits that *Hideaki* fails to disclose a thickened bottom portion as claimed but nevertheless asserts that one of ordinary skill in the art would have increased the bottom thickness to within the claimed range in view of *Hideaki* and *Beck* for "adequate structural support." See, final Office Action, page 4, lines 8-9; and page 5, lines 1-2. Appellants respectfully submit that one of ordinary skill in the art would have no reason to adjust the thicknesses of the various portions of the bottom of *Beck* to within the claimed thickness ranges.

For example, *Beck* discloses that the thickness "A" between its feet is between 0.060 and 0.087 inches (1,524 to 2,210 μm). See, *Beck*, column 7, lines 33-34. This thickness is much greater than the 100 to 200 μm claimed range. *Beck* also discloses that more material is provided in its feet such that the thickness of its feet is between 0.008 and 0.14 inches (203 to 3,556 μm). See, *Beck*, column 7, lines 29-32. These values are both substantially greater than the claimed

thickness ranges. In addition, *Beck* teaches that "without the redistribution of the material and the reinforcing ring of the present invention, merely reducing weight is insufficient to obtain a structurally sound bottle." See, *Beck*, column 7, lines 21-23. Therefore, one skilled in the art would have no reason to merely reduce the thicknesses of the feet of *Beck* to arrive at the claimed thickness values.

Further, the combination of references proposed by the Examiner appears to be improper hindsight reconstruction of the present claims. The Federal Circuit has held that it is "impermissible to use the claimed invention as an instruction manual or 'template' to piece together the teachings of the prior art so that the claimed invention is rendered obvious." *In re Fritch*, 23 U.S.P.Q.2d 1780, 1784 (Fed. Cir. 1992). "One cannot use hindsight reconstruction to pick and choose among isolated disclosures in the prior art to deprecate the claimed invention." *In re Fine*, 837 F.2d 1071 (Fed. Cir. 1988). The Examiner admits that the cited references fail to disclose several of the claimed structural limitations but simply asserts that such design limitations would be a matter of mere routine optimization to one of ordinary skill in the art. See, e.g., final Office Action, page 4, lines 8-9; page 5, lines 1-2 and 10-15. However, as discussed previously, a primary goal in this art is to simultaneously reduce the weight of plastic used and maintain the structural integrity of the beverage bottle. Yet one skilled in the art would understand, as evidenced by *Beck* and *Hideaki*, that this goal cannot be achieved by mere "optimization" or reduction of wall thicknesses without redesigning or redistributing the plastic material because mere reduction of weight can compromise the structural integrity of the bottle. See, *Beck*, column 7, lines 21-23; *Hideaki*, page 6, paragraph 10, lines 3-5.

Accordingly, Appellants respectfully request that the rejection of Claims 1, 3, 5-11, 13-19 and 21-24 under 35 U.S.C. §103(a) to *Hideaki*, *Beck* and *Hutchinson* be withdrawn.

In sum, the cited references fail to disclose or suggest every element of independent Claims 1 and 6. Moreover, the cited references fail to recognize the advantages, benefits and/or properties of the food product dispensers in accordance with the present claims. Consequently, independent Claims 1 and 6, along with the claims that depend therefrom, are novel, non-obvious and inventive over the prior art.

D. THE REJECTION OF CLAIMS 12 AND 20 UNDER 35 U.S.C. §103(a) IS RENDERED MOOT IN VIEW OF THE PATENTABILITY OF INDEPENDENT CLAIMS 1 AND 6

Claims 12 and 20 are rejected under 35 U.S.C. §103(a) as being unpatentable over *Hideaki*, *Beck* and *Hutchinson* in further view of U.S. Publication No. 2002/0185212 to Schaupp et al. ("*Schaupp*"). Appellants respectfully submit that the patentability of independent Claims 1 and 6 as discussed above renders moot the obviousness rejections of Claims 12 and 20, which are dependent from Claims 6 and 1, respectively. In this regard, the cited art fails to teach or suggest the elements of Claims 12 and 20 and in combination with the novel elements of Claims 1 and 6. Accordingly, Appellants respectfully submit that Claims 12 and 20 are novel, nonobvious and distinguishable from the cited references and, therefore, are in condition for allowance.

Additionally, even if combinable, the cited references fail to disclose or suggest each and every element of Claims 12 and 20. As discussed above, *Hideaki*, *Beck* and *Hutchinson* fail to disclose or suggest a container wherein: (1) the ratio weight of the walls to the weight of the bottom is between 3 and 4; (2) the ratio volume, in ml, of the body of the container per gram of PET of the body is between 80 and 120; (3) the part of the bottom between the feet has a thickness between 100 and 200 μm; and (4) each foot has a thickness between 50 and 150 μm as required, in part, by independent Claims 1 and 6 from which Claims 12 and 20 depend. The Examiner relies on *Schaupp* merely as support for pad printed images on the outside of the container. See, final Office Action, page 7, lines 14-16. Thus, Appellants respectfully submit that, even if properly combinable, *Schaupp* fails to remedy the deficiencies of *Hideaki*, *Beck* and *Hutchinson* with respect to Claims 12 and 20. For at least the reasons discussed above, the combination of *Hideaki, Beck, Hutchinson* and *Schaupp* is improper and, thus, fails to render the claimed subject matter obvious.

Accordingly, Appellants respectfully request that the rejection of Claims 12 and 20 under 35 U.S.C. §103(a) to *Hideaki*, *Beck*, *Hutchinson* and *Schaupp* be reconsidered and withdrawn.

Finally, Appellants note that the Examiner states that "if [Appellants] decide to file another appeal brief the means plus function language in claim 6 must be addressed or the brief will be considered defective." See, final Office Action, page 9, lines 21-22. In response, Appellants note that the means plus function language has been adequately addressed in the citations to the specification (WO 2005/047120) found at Section V, page 6 of the instant Appeal

Brief. Further, Appellants note that the specification clearly cites that the "closure means" may include either a cap or a sealed membrane. See, specification, page 4, lines 23-34. As such, Appellants respectfully submit that the means plus function language in Claim 6 is properly addressed and, therefore, the instant Appeal Brief is not defective.

VIII. CONCLUSION

Appellants respectfully submit that the Examiner has failed to establish a *prima facie* case of obviousness under 35 U.S.C. §103 with respect to the rejections of Claims 1, 3 and 5-24. Accordingly, Appellants respectfully submit that the obviousness rejections are erroneous in law and in fact and should therefore be reversed by this Board.

The Director is authorized to charge $540.00 for the Appeal Brief and any additional fees which may be required, or to credit any overpayment to Deposit Account No. 02-1818. If such a withdrawal is made, please indicate the Attorney Docket No. 3712036-00915 on the account statement.

Respectfully submitted,

K&L GATES LLP

BY _____

Robert M. Barrett
Reg. No. 30,142
Customer No. 29157
Phone No. 312-807-4204

Dated: October 5, 2010

CLAIMS APPENDIX

PENDING CLAIMS ON APPEAL OF U.S. PATENT APPLICATION SERIAL NO. 10/595,618

1. A container comprising a body formed by walls and a bottom, the body having as its greatest diameter a dimension d_1 and a neck with an internal diameter d_2, said container being made from a semi-crystalline PET, the body of said container comprising at its bottom at least three feet spaced from each other and being integral with said body,

wherein the ratio weight of the walls to the weight of the bottom is between 3 and 4 and the ratio volume, in ml, of the body of the container per gram of PET of the body is between 80 and 120, and wherein:

the walls of the body have a thickness of less than 100 μm;

the part of the bottom between the feet has a thickness between 100 and 200 μm; and

each foot has a thickness between 50 and 150 μm.

3. A container according to claim 1, wherein the neck has a wall thickness between 150 and 250 μm.

5. A container according to claim 1, wherein the part of the bottom between the feet has a greater thickness than that of the walls.

6. A packaging assembly comprising:

a container comprising a body formed by walls and a body, having as its greatest diameter a dimension d_1 and a neck with an internal diameter d_2, said container being made from a semi-crystalline PET, the body of said container comprising at its bottom at least three feet spaced from each other and being integral with said body, wherein the ratio weight of the walls to the weight of the bottom is between 3 and 4 and the ratio volume, in ml, of the body of the container per gram of PET of the body is between 80 and 120, and wherein: the walls of the body have a thickness of less than 100 μm; the part of the bottom between the feet has a thickness between 100 and 200 μm; and each foot has a thickness between 50 and 150 μm;

a product in the container; and

closing means for closing off or distributing the product from the neck.

7. A packaging assembly according to claim 6, wherein the product is selected from the group consisting of pasty, liquid, semi-liquid, granular and powdered product.

8. A packaging assembly according to claim 6, wherein said assembly has a high resistance to vertical and/or transverse loads allowing good resistance to transportation.

9. A packaging assembly according to claim 8, wherein said assembly supports a vertical and/or transverse loading of more than about 100 kg for a container having a weight of about 4 g.

10. A packaging assembly according to claim 46, wherein the body of the container has a form selected from the group consisting of: a three dimensional shape convenient for gripping, an ovoid, spherical, elliptical and cylindrical shape.

11. A packaging assembly according to claim 46, wherein the wall thickness of the body, substantially in the middle of the body is between 30 and 70 μm.

12. A packaging assembly according to claim 46, wherein the container comprises on its outside a printing made by pad printing.

13. A packaging assembly according to claim 46, wherein the ratio of d2 to d1 is between 1:3 and 1:10.

14. A packaging assembly according to claim 46, wherein the height ratio of the neck to the body is between 1:1 and 1:4.

15. A packaging assembly according to claim 46, wherein the ratio weight of the walls to the weight of the bottom is between 3.4 and 3.8.

16. A packaging assembly according to claim 46, wherein the ratio volume, in ml, of the body of the container per gram of PET of the body is between 90 and 110.

17. A process for manufacturing a container according to claim 1, wherein said container is obtained by stretch blow forming of a PET preform with high stretch index in comparison with the classical stretching of a preform.

18. A container according to claim 1, wherein the body of the container has a form selected from the group consisting of a three dimensional shape convenient for gripping, an ovoid, spherical, elliptical and cylindrical shape.

19. A container according to claim 1, wherein the wall thickness of the body, substantially in the middle of the body is between 30 and 70 μm.

20. A container according to claim 1, wherein the container comprises on its outside a printing made by pad printing.

21. A container according to claim 1, wherein the ratio of d2 to d1 is between 1:3 and 1:10.

22. A container according to claim 1, wherein the height ratio of the neck to the body is between 1:1 and 1:4.

23. A container according to claim 1, wherein the ratio weight of the walls to the weight of the bottom is between 3.4 and 3.8.

24. A container according to claim 1, wherein the ratio volume, in ml, of the body of the container per gram of PET of the body is between 90 and 110.

EVIDENCE APPENDIX

EXHIBIT A: Non-final Office Action dated February 3, 2010

EXHIBIT B: Final Office Action dated July 15, 2010

EXHIBIT C: JP 2001-1222374 to Hideaki et al. ("*Hideaki*")

EXHIBIT D: U.S. Patent No. 5,614,148 to Beck et al. ("*Beck*")

EXHIBIT E: U.S. Publication No. 2003/0031814 to Hutchinson et al. ("*Hutchinson*")

EXHIBIT F: U.S. Publication No. 2002/0185212 to Schaupp et al. ("*Schaupp*")

RELATED PROCEEDINGS APPENDIX

None.

EXHIBIT A

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/595,618	05/01/2006	Cyrille Durand	3712036-915	3622

29157 7590 02/03/2010

K&L Gates LLP
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EXAMINER	
NELSON, MICHAEL B	
ART UNIT	PAPER NUMBER
1794	

NOTIFICATION DATE	DELIVERY MODE
02/03/2010	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

chicago.patents@klgates.com

Office Action Summary	Application No.	Applicant(s)	
	10/595,618	DURAND ET AL.	
	Examiner	Art Unit	
	MICHAEL B. NELSON	1794	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *03 December 2009*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,3 and 5-24* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1, 3, 5-24* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

1. In view of the appeal brief filed on 12/14/09, PROSECUTION IS HEREBY REOPENED.

To avoid abandonment of the application, appellant must exercise one of the following two options:

(1) file a reply under 37 CFR 1.111 (if this Office action is non-final) or a reply under 37 CFR 1.113 (if this Office action is final); or,

(2) initiate a new appeal by filing a notice of appeal under 37 CFR 41.31 followed by an appeal brief under 37 CFR 41.37. The previously paid notice of appeal fee and appeal brief fee can be applied to the new appeal. If, however, the appeal fees set forth in 37 CFR 41.20 have been increased since they were previously paid, then appellant must pay the difference between the increased fees and the amount previously paid.

A Supervisory Patent Examiner (SPE) has approved of reopening prosecution by signing below:

/David R. Sample/
Supervisory Patent Examiner, Art Unit 1794

Examiner's note

2. Prosecution has been reopened to address the 112 6th paragraph "means for" language of claim 6. Applicant is advised that their appeal brief is defective for not addressing the means for language: "(1) identify, for each independent claim involved in the appeal and for each dependent claim argued separately, every means plus function and step plus function under 35. U.S.C. 112, sixth paragraph...". 37 CFR 41.37(c)(1)(v).

35 USC § 112 6th paragraph

3. Applicant has used "means for" language in claim 6, (closing means for closing off). This language meets the three prong requirement for 6th paragraph language. MPEP 2181(I). The examiner will consider the "means for closing off" language to be read upon by the "screw" cap disclosed in the instant specification at page 11.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5. Claims 6-16 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claim 6 recites the phrase "substantially incompressible" which renders the claim indefinite in that it is unclear what qualifies as "substantially incompressible." In addition to the relative uncertainty given to the term by the phrase "substantially" the examiner notes that all PET bottles exhibit some degree of compression when being squeezed by hand (i.e. it is unclear how much compression is permissible under the current limitations). Also, there is inadequate definition to ascertain under what conditions this testing (i.e. the squeezing of the bottle) would

be taken. Various independent factors would affect the resiliency of a bottle (the type of liquid in the bottle, how much head space there is, how good of a seal is on the bottle, how much the bottle is pressurized and how much force is being applied to the bottle).

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

7. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

8. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

9. Claims 1, 3, 5-11, 13-19 and 21-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hideaki et al. (JP 2001-122237), see translation, in view of Beck et al. (U.S. 5614148) with evidentiary support from Hutchinson et al. (U.S. 2003/0031814).

10. Regarding claims 1, 3, 5-11, 13-19 and 21-24, Hideaki et al. discloses a bottle for packaging a liquid beverage product (Fig. 1 and [0001]). The bottle is formed by stretch blow molding [0008] and given that the general inventive concept is for reduced thickness walls as a result of the stretching, the stretch would take place at higher than normal stretch ratios. The bottle has a neck, which functions as a closing means and a distribution means, side walls and a bottom (Fig. 1). The bottle is disclosed as having ribs at intervals along the wall to provide deformation strength ([0006]) and in general the filled bottle would be substantially incompressible by hand. The diameter of the neck is smaller than the diameter of the wall portions (Fig. 1). Also the container is made of PET ([0002]).

Hideaki et al. does not explicitly disclose the presence of feet in the bottle. Beck et al. discloses a bottle bottom configuration with five separate feet (Fig. 5), which facilitates improved stability when the bottle is placed vertically onto a flat surface (See Abstract). The inventions of both Hideaki et al. and Beck et al. are drawn to the field of blow molded PET bottles and therefore it would have been obvious to one having ordinary skill in the art at the time of the invention to have modified the unspecified bottom of the bottle of Hideaki et al. by using the bottom configuration as taught by Beck et al. with its multiple legs for the purposes of imparting improved stability when the bottle is placed vertically onto a flat surface.

Regarding the thickness limitations, Hideaki et al. discloses that the walls, 3, to the bottom, 4, have a thickness of between 20 and 50 micrometers while the un-stretched neck

portion has a thickness of between 200 and 500 micrometers ([0007]-[0010]). Hideaki et al. does not disclose a thickened bottom portion as instantly claimed. Beck et al. shows that a structurally resilient bottom portion structure. The thickness of the wall portions, D1, and the tip of the feet, B, are relatively thin compared to the thickness in between the feet portions, A, (Fig. 3). The added thickness in the bottom portion provides extra stability to the bottle for when the bottle is set down on a table or dropped on the floor (i.e. one having ordinary skill in the art would find if obvious that the bottom of a bottle benefits from added structural support). Hideaki discloses that the bottle of his invention has two wall thicknesses: a structurally stable wall thickness of 0.2-0.3 mm (i.e. for the shoulders of the bottle as seen in Fig. 1 and 2) and a ultra thin thickness of 0.02-0.05 (See Claim 1). Hence to create the structurally stable bottom portion for the bottle of Hideaki (as would be obvious to one having ordinary skill as explained above) the wall thickness of 0.2-0.3 mm would be used in the thicker bottom portions (i.e. in between the feet) and the wall thickness of 0.02 to 0.05 would be used for the thinner portions (i.e. the feet and the container walls). Moreover, while Beck et al. shows the general structure of the bottom of a container, the exact thicknesses of the various portions of the container would have been adjusted by one having ordinary skill in the art to provide both adequate structural support and still reduce the cost to manufacture as much as possible.

Regarding the volume per gram of PET of the bottle of modified Hideaki et al, while modified Hideaki et al. does not explicitly mention that the volume/gram is within the claimed range, given the disclosure towards using less resin to achieve equivalent volume containment ([0003]), and given the substantially similar wall thickness, one having ordinary skill in the art would optimize the volume of the container in relation to the amount of PET used in the

container by altering the shape and wall thickness of the container in order to reduce production costs of the container.

Regarding the weight ratio of the weight of the wall section compared to the weight of the bottom section, while modified Hideaki et al. does not explicitly state that his bottle has a ratio which falls within the claimed range, one having ordinary skill in the art would have optimized the weight of the wall portion of the container to the bottom portion of the container as part of the general design process for determining the shape and wall thickness of various parts of the container, (as explained above).

While modified Hideaki does not explicitly disclose the semi-crystalline nature of the PET used in their bottles, one having ordinary skill in the art of blow molded PET bottles would realize that semi-crystalline PET is conventionally used for blow molding operations due to is advantageous rheological properties (See for example Hutchinson et al., [0007]).

The bottle of modified Hideaki has a greater section in that there is a maximum diameter of the bottle along its walls.

The bottle of Hideaki also has a screw cap (Fig. 1) which reads on the instant means for closing (instant specification page 11).

Additionally, Hideaki et al. discloses that the walls, 3, to the bottom, 4, have a thickness of between 20 and 50 micrometers while the un-stretched neck portion has a thickness of between 200 and 500 micrometers ([0007]-[0010]). Beck et al. discloses that each foot part has an increased thickness part (Fig. 3, A, and Table 1). Blow molded bottles of the type in Hideaki et al. and Beck et al. are designed to hold beverages (i.e. liquid). When filed with such a liquid and closed, the bottle of modified Hideaki et al. would be designed under the conventional

requirement of beverage containing blow molded bottles to be substantially highly resistant to the loads typically associated with handling and shipping (i.e. incompressible), including those recited in instant claim 9. The body of the bottle has a substantially cylindrical shape (Fig. 1). Numerous external aesthetic adornments, including pad printing of images or indicia, would be obvious to one having ordinary skill as providing increased commercial appeal.

Regarding the ratio of the diameter of the body to the neck (including the maximum diameter of the body, i.e. d_1 to d_2), one having ordinary skill in the art would have adjusted, through routine experimentation, the ratio of the neck opening to body diameter in order to control the aesthetic appeal of the finished bottle and in order to optimize the speed at which the bottle could empty its liquid contents and the total time required for the bottle to empty its contents.

Regarding the ratio of the height of the neck and the height of the body, one having ordinary skill in the art would have adjusted, through routine experimentation, the height ratio of the neck to the body in order to control the aesthetic appeal of the finish bottle and in order to optimize the total volume of the container in relation to the strength of the closure mechanism of the bottle (i.e. the higher the neck length the more area there is for engagement between the twist top type closure commonly associated with blow molded PET bottles and the bottle itself).

11. Claims 12 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hideaki et al. (JP 2001-122237), see translation, in view of Beck et al. (U.S. 5614148) with evidentiary support from Hutchinson et al. (U.S. 2003/0031814), as applied to claims 4 and 6 above, and further in view of Schaupp et al. (U.S. 2002/0185212).

Regarding claims 12 and 20, modified Hideaki discloses all of the limitations as set forth above. Modified Hideaki does not explicitly disclose that the bottles be adorned with printed images. Schaupp et al. discloses an apparatus which allows for the pad printing ([0014]) of bottles (See Abstract) which one having ordinary skill in the art would appreciate to be advantageous because the printed image results in improved aesthetic appeal to the consumer. Hence it would have been obvious to have pad printed images onto the bottle of modified Hideaki as taught by Schaupp et al.

Conclusion

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to MICHAEL B. NELSON whose telephone number is (571) 270-3877. The examiner can normally be reached on Monday through Thursday 6AM-4:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David Sample can be reached on (571) 272-1376. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only.

For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/David R. Sample/
Supervisory Patent Examiner, Art Unit 1794

/MN/
01/25/10

EXHIBIT B

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/595,618	05/01/2006	Cyrille Durand	3712036-915	3622

29157 7590 07/15/2010

K&L Gates LLP
P.O. Box 1135
CHICAGO, IL 60690

EXAMINER	
NELSON, MICHAEL B	
ART UNIT	PAPER NUMBER
1783	

NOTIFICATION DATE	DELIVERY MODE
07/15/2010	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

chicago.patents@klgates.com

Office Action Summary	Application No.	Applicant(s)	
	10/595,618	DURAND ET AL.	
	Examiner	Art Unit	
	MICHAEL B. NELSON	1783	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *21 June 2010*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,3 and 5-24* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1, 3, 5-24* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

1. Applicant's amendment of 06/21/10 has been entered. Claims 1, 3, 5-24 are currently under examination on the merits. The previous 112 rejection is withdrawn. The examiner acknowledges that the means for closing can also include caps and sealed membranes in addition to the screw cap mentioned in the previous office action.

35 USC § 112 6th paragraph

2. Applicant has used "means for" language in claim 6, (closing means for closing off). This language meets the three prong requirement for 6th paragraph language. MPEP 2181(I). The examiner will consider the "means for closing off" language to be read upon by the "caps or sealed membranes" disclosed in the instant specification at paragraph 18.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

5. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

6. Claims 1, 3, 5-11, 13-19 and 21-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hideaki et al. (JP 2001-122237), see translation, in view of Beck et al. (U.S. 5614148) in view of Hutchinson et al. (U.S. 2003/0031814).

7. Regarding claims 1, 6, 15-17 and 23 and 24, Hideaki et al. discloses a bottle for packaging a liquid beverage product (Fig. 1 and [0001]). The bottle is formed by stretch blow molding [0008] and given that the general inventive concept is for reduced thickness walls as a result of the stretching, the stretch would take place at higher than normal stretch ratios. The bottle has a neck, which functions as a closing means and a distribution means, side walls and a bottom (Fig. 1). The bottle is disclosed as having ribs at intervals along the wall to provide deformation strength ([0006]) and in general the filled bottle would be substantially incompressible by hand. The diameter of the neck is smaller than the diameter of the wall portions (Fig. 1). Also the container is made of PET ([0002]).

Hideaki et al. does not explicitly disclose the presence of feet in the bottle. Beck et al. discloses a bottle bottom configuration with five separate feet (Fig. 5), which facilitates improved stability when the bottle is placed vertically onto a flat surface (See Abstract). The

inventions of both Hideaki et al. and Beck et al. are drawn to the field of blow molded PET bottles and therefore it would have been obvious to one having ordinary skill in the art at the time of the invention to have modified the unspecified bottom of the bottle of Hideaki et al. by using the bottom configuration as taught by Beck et al. with its multiple legs for the purposes of imparting improved stability when the bottle is placed vertically onto a flat surface.

Regarding the thickness limitations, Hideaki et al. discloses that the walls, 3, to the bottom, 4, have a thickness of between 20 and 50 micrometers while the un-stretched neck portion has a thickness of between 200 and 500 micrometers ([0007]-[0010]). Hideaki et al. does not disclose a thickened bottom portion as instantly claimed. Beck et al. shows that a structurally resilient bottom portion structure. The thickness of the wall portions, D1, and the tip of the feet, B, are relatively thin compared to the thickness in between the feet portions, A, (Fig. 3). The added thickness in the bottom portion provides extra stability to the bottle for when the bottle is set down on a table or dropped on the floor (i.e. one having ordinary skill in the art would find if obvious that the bottom of a bottle benefits from added structural support). Hideaki discloses that the bottle of his invention has two wall thicknesses: a structurally stable wall thickness of 0.2-0.3 mm (i.e. for the shoulders of the bottle as seen in Fig. 1 and 2) and a ultra thin thickness of 0.02-0.05 (See Claim 1). Hence to create the structurally stable bottom portion for the bottle of Hideaki (as would be obvious to one having ordinary skill as explained above) the wall thickness of 0.2-0.3 mm would be used in the thicker bottom portions (i.e. in between the feet) and the wall thickness of 0.02 to 0.05 would be used for the thinner portions (i.e. the feet and the container walls). Moreover, while Beck et al. shows the general structure of the bottom of a container, the exact thicknesses of the various portions of the container would

have been adjusted by one having ordinary skill in the art to provide both adequate structural support and still reduce the cost to manufacture as much as possible.

Regarding the volume per gram of PET of the bottle of modified Hideaki et al, while modified Hideaki et al. does not explicitly mention that the volume/gram is within the claimed range, given the disclosure towards using less resin to achieve equivalent volume containment ([0003]), and given the substantially similar wall thickness, one having ordinary skill in the art would optimize the volume of the container in relation to the amount of PET used in the container by altering the shape and wall thickness of the container in order to reduce production costs of the container.

Regarding the weight ratio of the weight of the wall section compared to the weight of the bottom section, while modified Hideaki et al. does not explicitly state that his bottle has a ratio which falls within the claimed range, one having ordinary skill in the art would have optimized the weight of the wall portion of the container to the bottom portion of the container as part of the general design process for determining the shape and wall thickness of various parts of the container, (as explained above).

While modified Hideaki does not explicitly disclose the semi-crystalline nature of the PET used in their bottles, one having ordinary skill in the art of blow molded PET bottles would realize that semi-crystalline PET is conventionally used for blow molding operations due to is advantageous rheological properties (See for example Hutchinson et al., [0007]).

The bottle of modified Hideaki has a greater section in that there is a maximum diameter of the bottle along its walls.

The bottle of Hideaki also has a screw cap (Fig. 1) which reads on the instant means for closing (instant specification page 11).

Additionally, with respect to claims 3, 11 and 19, Hideaki et al. discloses that the walls, 3, to the bottom, 4, have a thickness of between 20 and 50 micrometers while the un-stretched neck portion has a thickness of between 200 and 500 micrometers ([0007]-[0010]). With respect to claim 5, Beck et al. discloses that each foot part has an increased thickness part (Fig. 3, A, and Table 1). With respect to claim 7, Blow molded bottles of the type in Hideaki et al. and Beck et al. are designed to hold beverages (i.e. liquid). With respect to claim 8 and 9, when filed with such a liquid and closed, the bottle of modified Hideaki et al. would be designed under the conventional requirement of beverage containing blow molded bottles to be substantially highly resistant to the loads typically associated with handling and shipping (i.e. incompressible), including those recited in instant claim 9. With respect to claims 10 and 18, the body of the bottle has a substantially cylindrical shape (Fig. 1). Numerous external aesthetic adornments, including pad printing of images or indicia, would be obvious to one having ordinary skill as providing increased commercial appeal.

With respect to claims 13 and 21, regarding the ratio of the diameter of the body to the neck (including the maximum diameter of the body, i.e. d_1 to d_2), one having ordinary skill in the art would have adjusted, through routine experimentation, the ratio of the neck opening to body diameter in order to control the aesthetic appeal of the finished bottle and in order to optimize the speed at which the bottle could empty its liquid contents and the total time required for the bottle to empty its contents.

With respect to claims 14 and 22, regarding the ratio of the height of the neck and the height of the body, one having ordinary skill in the art would have adjusted, through routine experimentation, the height ratio of the neck to the body in order to control the aesthetic appeal of the finish bottle and in order to optimize the total volume of the container in relation to the strength of the closure mechanism of the bottle (i.e. the higher the neck length the more area there is for engagement between the twist top type closure commonly associated with blow molded PET bottles and the bottle itself).

8. Claims 12 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hideaki et al. (JP 2001-122237), see translation, in view of Beck et al. (U.S. 5614148) in view of Hutchinson et al. (U.S. 2003/0031814), as applied to claims 4 and 6 above, and further in view of Schaupp et al. (U.S. 2002/0185212).

Regarding claims 12 and 20, modified Hideaki discloses all of the limitations as set forth above. Modified Hideaki does not explicitly disclose that the bottles be adorned with printed images. Schaupp et al. discloses an apparatus which allows for the pad printing ([0014]) of bottles (See Abstract) which one having ordinary skill in the art would appreciate to be advantageous because the printed image results in improved aesthetic appeal to the consumer. Hence it would have been obvious to have pad printed images onto the bottle of modified Hideaki as taught by Schaupp et al.

Response to Arguments

9. Applicant's arguments of 06/21/10 have been considered but are not persuasive.

10. Applicant argues that it would not have been obvious to have arrived at the instant wall to bottom weight ratio. The examiner disagrees. As part of the routine procedure of adjusting the

scale and shape of the bottles, along with the inventive thicknesses taught by the references, one having ordinary skill would arrive at many different shapes having many different wall thicknesses, wall heights and bottle body diameters and as such would arrive at many different wall to bottom weight ratios, including those as instantly claimed. Particularly, keeping the same basic configuration as taught in the references and making the bottle taller or shorter to accommodate different volumes of liquid would greatly change the ratio. The examiner also notes that there is nothing on the record to indicate where the "bottom" of the bottle ends and the "walls" begin or end.

11. Regarding applicants arguments against the volume per gram of PET, along the same reasoning set forth above, adjusting the shape and scale of the bottle would adjust the volume per gram of PET. For example making the bottle more spherical would increase its volume capacity per gram of PET whereas making the bottle cylindrical, especially a very narrow cylinder with the same wall thicknesses, would decrease the volume to PET ratio. Also, considering that the walls are much thinner than the neck and the bottom, adjusting the height of the bottles of the prior art would change the volume to PET ratio. As above, in the process of adjusting the shape and size of the container, the bottles ratio would be adjusted to fall within the instant ranges. Applicant argues that Beck uses a specific example of a 2 liter bottle, however, this example is not limiting.

12. Finally, applicant argues that Beck teaches away from using its foot configuration with the wall thicknesses of Hideaki. This is not the case. Applicant repeatedly cites to a portion that teaches that reducing the weight in the bottom of a bottle is insufficient. This actually teaches for the combination of the two references because all the bottom of Hideaki possess in terms of

structure is a reduced weight. Therefore it would have been obvious to have used the configuration of Beck, with its specifically positioned thick and thin portions to allow for the reduced thickness to be implemented without unduly sacrificing structural integrity. Specifically applicant argues: "Beck specifically acknowledges that simply decreasing the weight of the bottom portion of the bottle," (i.e. as was taught by Hideaki) "without also redesigning the bottle," (i.e. according to the structural design of Beck) "is an inadequate method for achieving a reduced-weight bottle with sufficient" (Remarks, Page 5). Hence the cited portion of Beck discloses that his structural design should be used with techniques that aim at reducing bottle weight by reducing thicknesses (i.e. Hideaki).

13. In short, Hideaki discloses a method for making a bottle with ultrathin wall portions and structurally stable thick portions (Fig. 1 and 2). Hideaki is silent as to the particular structure of the bottom but says that it should preferably have a thicker wall thickness. Beck discloses a bottom structure that has feet with a thickness equal to the wall thickness of the bottle, (Fig. 3, W and B) and a thicker portion in between the feet (Fig. 3, A) which gives structural stability. It would have been obvious to have used the foot structure of Beck, with the thin and thick (i.e. stable) wall thickness of Hideaki, to allow for a bottled with reduced overall PET weight, while still having sufficient structural stability in the foot area.

14. Applicant references Hutchinson however that reference was just used to show it was known to use semi-crystalline PET as a material in blown PET bottles and does not relate the structural layout of the bottle.

15. Applicant is also respectfully reminded that if they decide to file another appeal brief the means plus language in claim 6 must be addressed or the brief will be considered defective. The

appeal brief must: "(1) identify, for each independent claim involved in the appeal and for each dependent claim argued separately, every means plus function and step plus function under 35. U.S.C. 112, sixth paragraph...". 37 CFR 41.37(c)(1)(v).

Conclusion

16. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to MICHAEL B. NELSON whose telephone number is (571) 270-3877. The examiner can normally be reached on Monday through Thursday 6AM-4:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David Sample can be reached on (571) 272-1376. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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/Patricia L. Nordmeyer/
Primary Examiner, Art Unit 1783

/MN/
07/08/10

EXHIBIT C

PTO 08-7705

CC=JP DATE=20010508 KIND=A
PN=2001122237

ULTRATHIN-WALLED BOTTLE FORMED BY STRETCH BLOW MOLDING
[Enshin burooseikei ni yoru chouusuniku botoru]

Hideaki Koda

UNITED STATES PATENT AND TRADEMARK OFFICE
Washington, D.C. September 2008

Translated by: FLS, Inc.

PUBLICATION COUNTRY	(19):	JP
DOCUMENT NUMBER	(11):	2001122237
DOCUMENT KIND	(12):	A [PUBLISHED UNEXAMINED APPLICATION]
PUBLICATION DATE	(43):	20010508
APPLICATION NUMBER	(21):	11305351
APPLICATION DATE	(22):	19991027
INTERNATIONAL CLASSIFICATION	(51):	B65D 1/02; B29C 49/08; //B29K 67:00; B29L 22:00
INVENTOR	(72):	KODA, HIDEAKI
APPLICANT	(71):	DAIKIN INDUSTRIES, LTD.
TITLE	(54):	ULTRATHIN-WALLED BOTTLE FORMED BY STRETCH BLOW MOLDING
FOREIGN TITLE	(54A):	ENSHIN BUROOSEIKEI NI YORU CHOUUSUNIKU BOTORU

[Claims] /2*

[Claim 1] With respect to a bottle made of a synthetic resin obtained by vertically stretching an injection-molded preform in a blow die, expanding it in the lateral direction by means of air blow, and making the walls of the section of the bottle consisting of the shoulder part, which is located below the neck part, and the barrel part to be ultrathin,

an ultrathin-walled bottle obtained by stretch blow molding and characterized by forming the above shoulder part in a manner such that its walls will have the thickness of between 0.2 and 0.3mm and by forming the barrel part, which starts from the boundary with the shoulder part, and the portion below in a manner such that their walls will have the ultrathin thickness of between 0.02 and 0.05mm so that they can be pushed into the shoulder part at the time of disposal.

[Claim 2] An ultrathin-walled bottle defined in Claim 1 obtained by stretch blow molding, characterized by the periphery of the boundary between the shoulder part and barrel part being depressed in the shape of a ring for finger hooking and by many levels of lateral ribs of optional shapes being formed in the barrel part at predetermined intervals to provide the barrel part with deformation strength.

[Detailed Description of the Invention]

[0001]

[Technical Field of the Invention] This invention relates to an ultrathin-walled bottle formed by stretch-blowing a preform composed of an injection-molded thermoplastic resin, such as polyethylene

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* Claim and paragraph numbers correspond to those in the foreign text.

terephthalate.

[0002]

[Problem that the Invention is to Solve] There is a plan to enforce a recycling law regarding packaging bottles made of polyethylene terephthalate generally utilized as pet bottles, and in light of this, attempts are being made to reduce the amount of the resins used, to lower the weights, and to improve the transportation efficiency.

[0003] The thicknesses of the barrels of frequently-used conventional bottles for beverages having capacities of between 500 and 1000cc are between about 0.25 and 0.3mm. There are exceptional bottles that are thicker, but their barrels, while they can be crushed, cannot be stored in a folded condition. Moreover, even if a bottle has a foldable structure, it contributes only to decreasing the bulk of the barrel and not to drastically decreasing the amount of resin used or lowering the weight. Therefore, it is unrealistic to expect a significant effect in increasing the transportation volume and stockpile.

[0004] This invention was devised in light of the above situation, and its aim is to decrease the thicknesses of the bottles, specifically to form the bottles to have ultrathin walls in the barrel part and the portion below it, and to thereby supply ultrathin-walled bottles which are capable of realizing efficient transportation and stockpiling as a result of the decreased amount of resin used, lower weight, and smaller disposal sizes and which are therefore also capable of improving the economic efficiency of recycling.

[0005]

[Means for Solving the Problems] This invention, which has the above aim, is a bottle made of a synthetic resin obtained by vertically stretching an injection-molded preform in a blow die, expanding it in the lateral direction by means of air blow, and making the portion of the bottle that consists of the shoulder part, which is located below the neck part, and the barrel part to have ultrathin walls. It is specifically obtained by forming the above shoulder part in a manner such that its walls will have the thickness of between 0.2 and 0.3mm and by forming the barrel part, which starts from the boundary with the shoulder part, and the portion below it in a manner such that their walls will have the ultrathin thickness of between 0.02 and 0.05mm so that they can be pushed into the shoulder part at the time of disposal.

[0006] Moreover, according to this invention, the periphery of the boundary between the shoulder part and barrel part is depressed in the shape of a ring for finger hooking, and many levels of lateral ribs of optional shapes are formed in the barrel part at predetermined intervals to provide the barrel part with deformation strength.

[0007] An ultrathin-walled bottle having the above structure has a shoulder part that has walls approximately as thick as the walls of the barrel part of a regular bottle and also has a barrel part and the part below it that have walls much thinner than the walls of the shoulder part. Therefore, it requires a smaller amount of resin than a regular bottle and is therefore lighter. Moreover, since its bulk can be reduced at the time of disposal by having the barrel part and below it pushed into the shoulder part, it is possible to transport and stockpile a large

amount of [these bottles] for recycling. Therefore, the expenses required by transportation and stockpiling as well as the efforts related to collection can be reduced, and the economic efficiency of recycling is improved.

[0008]

[Embodiment of the Invention] The figure illustrates a circular bottle for beverages that is made of polyethylene terephthalate (PET) and that has a capacity of about 500cc. Reference numeral 1 denotes the neck part that has not been stretched, 2 denotes the shoulder part, 3 denotes the barrel part, and 4 denotes a bottom part having a domed-shaped center. The part from the shoulder part 2 to the bottom part 4 is made to have walls thinner than the walls of the neck part 1 by means of stretch blow molding.

[0009] Although omitted in the drawing, this bottle is formed in the same manner as a regular stretch-blown bottle by axially stretching a preform, which is composed of a neck part that will be the neck of the bottle without being altered and a bottom-equipped barrel part that will form the shoulder part to the bottom part after being subjected to stretch blowing, at the bottom-equipped barrel part and by also expanding it in the lateral direction by means of air blow inside a blow die while holding the neck part.

[0010] The thickness of the above shoulder part 2 is made to be between 0.2 and 0.5mm, which is less than the thickness (between 2.2 and 2.5mm) of the non-stretched neck part 1, by means of the above stretch blow molding. Moreover, the thickness of the walls of the portion from the barrel part

3 to the bottom part 4 is made to be between 0.02 and 0.05mm, which is drastically thinner than the walls of the shoulder part, which starts from the boundary 5 of the shoulder part 2. Since the bottom part 4 will have the load of the content applied to it, its walls should preferably be thicker than the walls of the barrel part 3.

[0011] The periphery of the above boundary 5 is depressed in the shape of a ring by means of inward bending of the lower end 2a of the shoulder part, and the ring-shaped depression allows the lower end 2a of the shoulder part to be used for finger hooking so that the bottle can be held or tilted without the ultrathin-walled barrel part 3 being grasped.

[0012] Moreover, since the barrel part 3 having the thickness between 0.02 and 0.05mm is susceptible to deformation as a result of even a slight lateral pressure and the self-standing properties of the bottle may become lost when the bottle is empty prior to the content being filled, the periphery of the barrel part 3 has provided to it many levels of a large number of wavy, symmetrical lateral ribs, 6 and 6, at predetermined intervals so that [the barrel part] is provided with deformation strength without making it impossible for the bottle to be crushed. Moreover, although it is omitted in the drawing, it is permissible to reinforce the strength of the bottom by also forming ribs radially in the bottom part 4, in which case the reinforcement should be limited to a degree that will still allow the bottom part 4 to be crushed at the time of disposal.

[0013] In this manner, a bottle having an ultrathin-walled barrel

part, which is between 0.02 and 0.05mm in wall thickness, drastically reduces the amount of resin used as well as substantially decreases the weight. Therefore, as illustrated in Figure 2, it can be crushed in the area from the barrel part 3 to the bottom part 4 easily by a hand after being used. Moreover, since the walls of the barrel part and the portion below it are ultrathin, the bottle will not be bulky when it is casually rolled up or folded after being crushed. Moreover, when pushed into the shoulder part in the above condition, the [rolled up or folded up] portion can be almost entirely contained inside the shoulder part 2, and therefore, the used bottle can be reduced in size to the combined size of the neck part 1 and shoulder part 2 and can be put in a recycling bag used in each household.

[0014] Therefore, since the amount of bottles that can be contained in a bag used in each household is increased compared to conventional regular bottles, the amount that can be collected each time is increased, and the transported and stockpiled amounts also increase, consequently decreasing the expenses required for these operations. Moreover, the amount of resin used per bottle decreases drastically, and the bottle's cost is also lowered. Therefore, the economic efficiency of recycling will improve greatly.

[Brief Description of the Figures]

[Figure 1] A front view of an ultrathin-walled bottle of the invention obtained by means of stretch blow molding, showing a half of it as a vertical cross-section.

[Figure 2] A vertical cross-sectional front view of the above

ultrathin bottle at the time of disposal.

[Explanation of the Reference Numerals]

1 = neck part

2 = shoulder part

2a = lower end of shoulder part

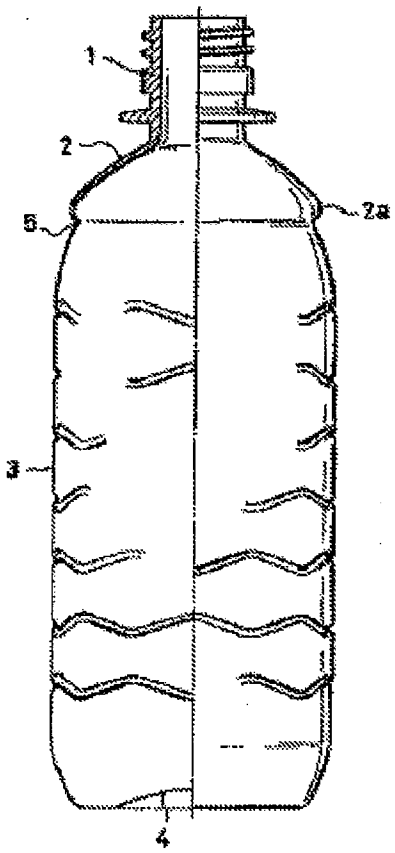
3 = barrel part

4 = bottom part

5 = boundary

6 = lateral rib

[Figure 1]



[Figure 2]

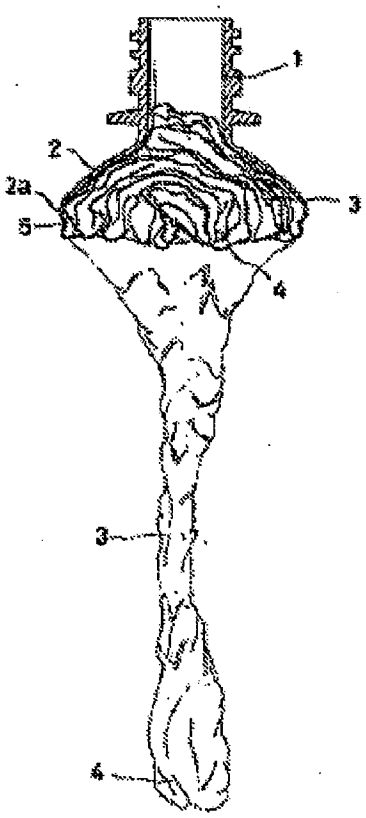


EXHIBIT D

US005614148A

United States Patent [19]

Beck et al.

[11] **Patent Number: 5,614,148**

[45] **Date of Patent: Mar. 25, 1997**

[54] **ONE PIECE SELF-STANDING BLOW MOLDED PLASTIC CONTAINERS MADE FROM A MONOBASE PREFORM**

[75] Inventors: **Martin H. Beck**; **George F. Rollend**, both of Amherst; **John H. Muszynski**, Auburn; **Lydia K. Reed**, Amherst; **Scott J. Hickey**, Hollis; **Dennis C. Connor**, Merrimack; **Robert Caldicott**, Nashua, all of N.H.

[73] Assignee: **DTL Technology Limited Partnership**, Amherst, N.H.

[21] Appl. No.: **380,647**

[22] Filed: **Jan. 30, 1995**

[51] **Int. Cl.**[6] **B29C 49/06**; B29D 23/00

[52] **U.S. Cl.** **264/532**; 264/537; 215/375; 428/36.92; 428/542.8

[58] **Field of Search** 264/532, 537, 264/523; 215/375; 220/606; 428/36.92, 542.8

[56] **References Cited**

U.S. PATENT DOCUMENTS

3,759,410	9/1973	Uhlig .	
4,108,324	8/1978	Krishnakumar et al. .	
4,247,012	1/1981	Alberghini .	
4,254,882	3/1981	Yoshino .	
4,403,706	9/1983	Mahajan .	
4,525,401	6/1985	Pocock et al. .	
4,725,464	2/1988	Collette .	
4,863,046	9/1989	Collette et al. .	
4,892,205	1/1990	Powers et al. .	
4,927,680	5/1990	Collette et al. .	
4,978,015	12/1990	Walker .	
5,104,706	4/1992	Krishnakumar et al. .	
5,160,059	11/1992	Collette et al. .	
5,353,954	10/1994	Steward et al. .	
5,427,258	6/1995	Krishnakumar et al. .	

FOREIGN PATENT DOCUMENTS

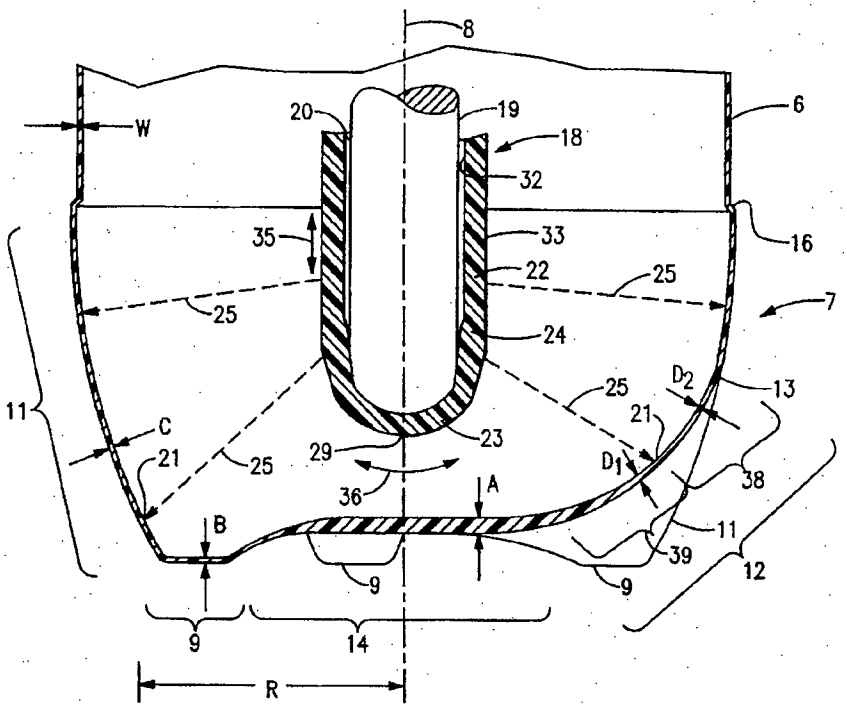
91/00139	1/1992	Australia .

Primary Examiner—Catherine Timm
Attorney, Agent, or Firm—Davis and Bujold

[57] **ABSTRACT**

The invention provides a light weight self-standing blow molded two liter carbonated beverage bottle having a unique petaloid base made from a monobase preform. The base comprises a petaloid design which has a plurality of at least three (preferably five) feet. The monobase preform has a thick reinforcing ring forming portion which remains unstretched during blowing. The reinforcing ring forming portion is thicker than both the sidewall forming portion and the gate area forming portion of the preform thereby resulting in increased stretching in both those areas. The reinforcing ring extends circumferentially around the base. By providing such a reinforcing ring, a bottle having a bigger foot radius and/or containing less material use can be realized. The resulting bottle has less stress whitening and greater stress crack resistance while at the same time using less material and/or having a larger radius than prior bottles.

10 Claims, 5 Drawing Sheets



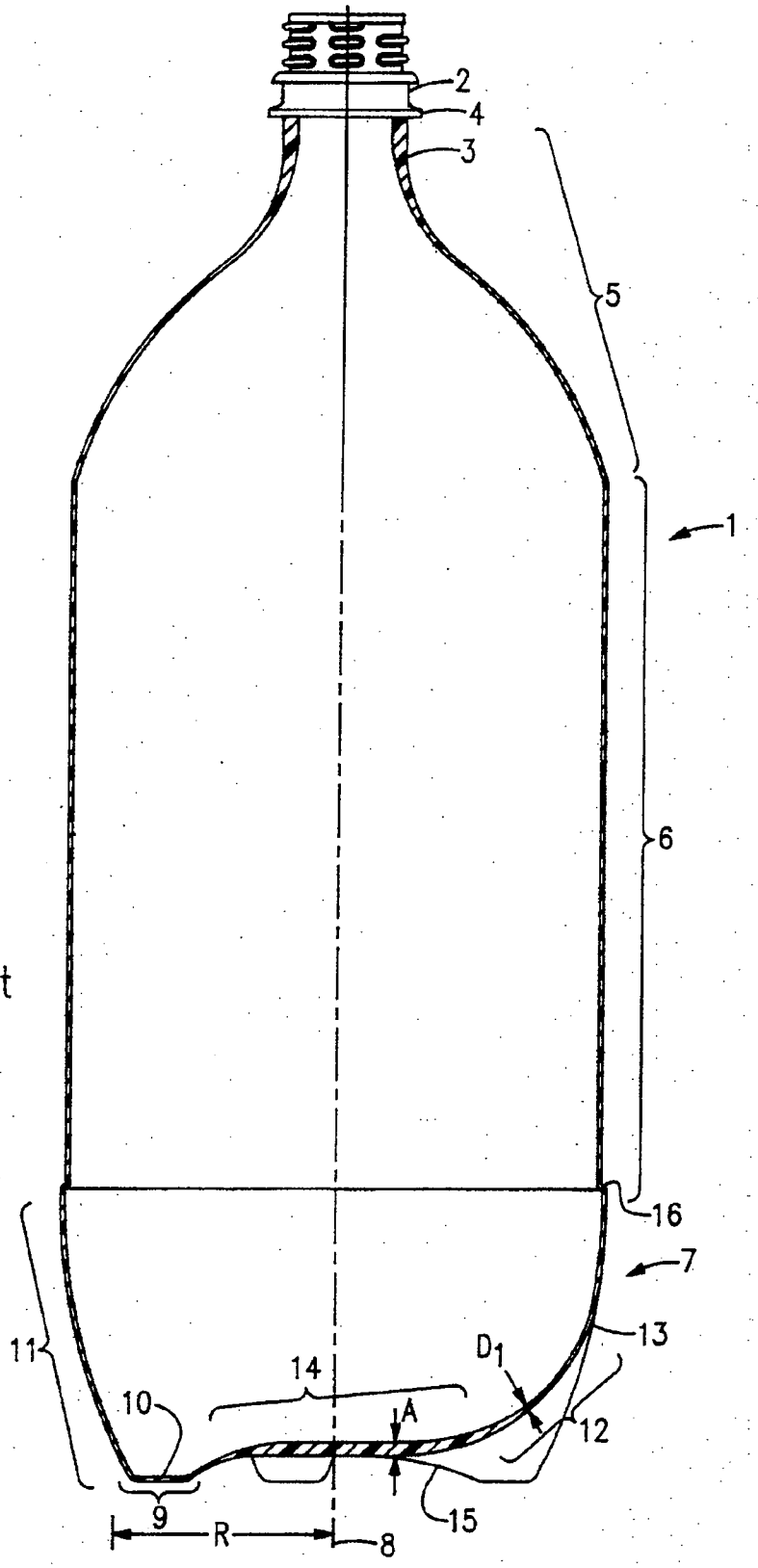


FIG.1
Prior Art

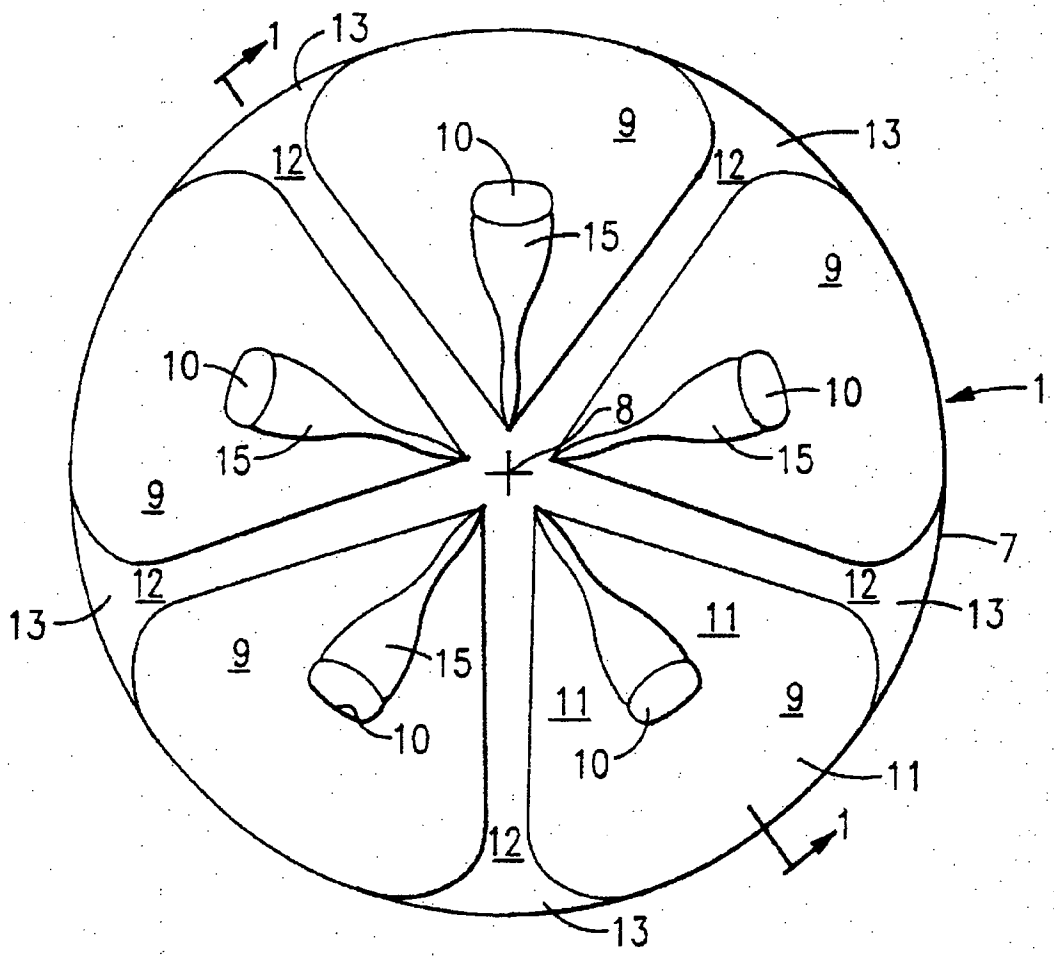


FIG.2
Prior Art

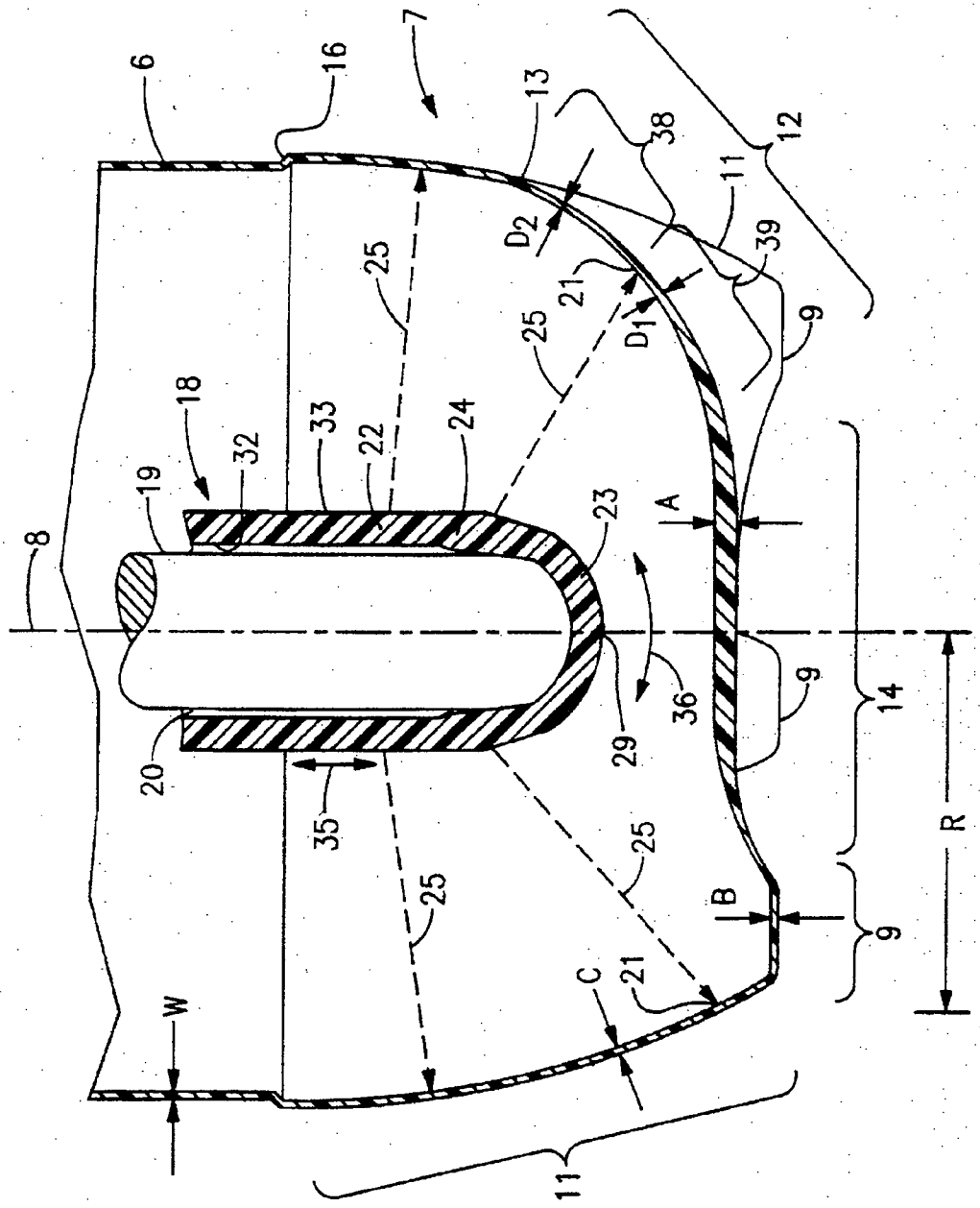

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FIG.3

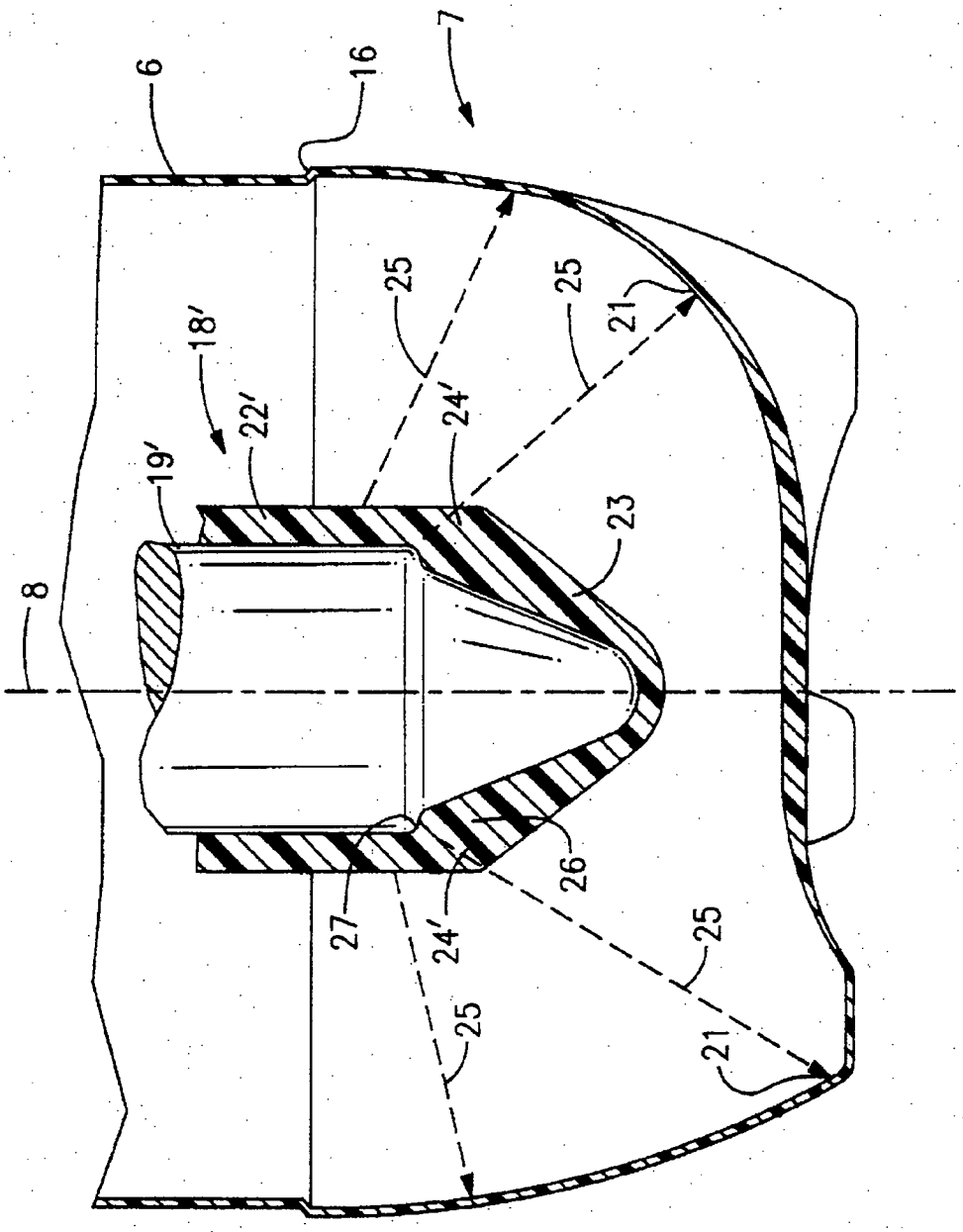

FIG.4

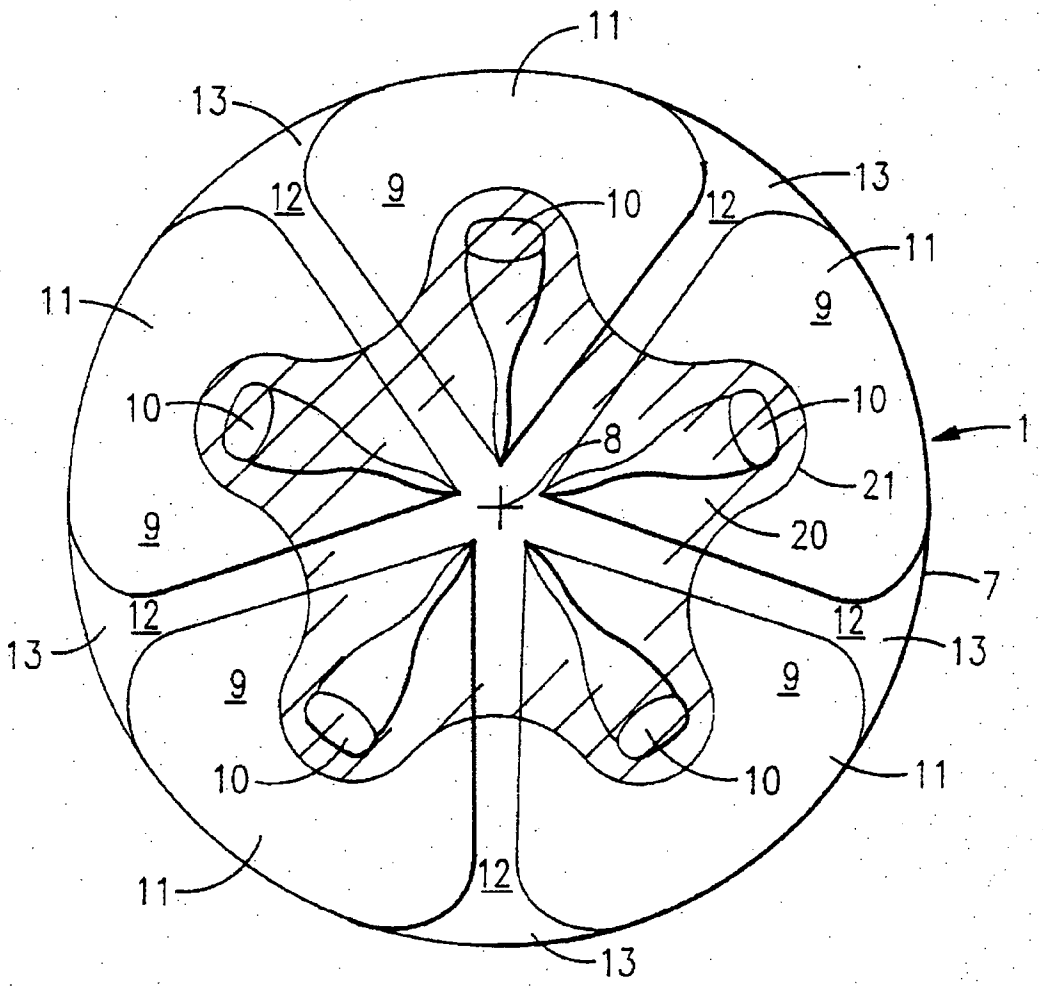
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FIG.5

ONE PIECE SELF-STANDING BLOW MOLDED PLASTIC CONTAINERS MADE FROM A MONOBASE PREFORM

The present invention relates to plastic containers for containing fluids under pressure and the methods of producing same and, more particularly, to a one-piece disposable plastic bottle of the petaloid base variety having a reinforcing ring and a stretched gate area. The monobase preform has a reinforcing ring forming portion. The reinforcing ring forming portion is thicker than at least the sidewall forming portion and also, usually, the gate area forming portion. The reinforcing ring extends circumferentially around the base. By providing such a reinforcing ring, a bottle base having a bigger foot radius and/or using less material can be realized. The resulting bottle has less stress whitening in the foot area and greater stress crack resistance.

BACKGROUND OF THE INVENTION

Blow molded plastic bottles have largely replaced the heavier glass bottles previously used for soft drinks, and the like. In a two liter bottle of plastic, the weight of the bottle itself is negligible as compared to the weight of a glass bottle of similar capacity. The first plastic bottles were generally two piece bottles comprising a pressure vessel portion and base which permitted the bottle to stand upright on shelves, and the like. The pressure vessel portion was typically of a tough, flexible plastic (e.g. polyester) which became resiliently rigid for gripping due to the internal pressure created by the carbon dioxide gas in the soft drink liquid contained therein. The bottom was hemispherical and the separate base was required in order for the bottle be able to stand by itself. The base was typically of a plastic such as polyethylene and is attached over the bottom of the pressure vessel portion with adhesive.

One alternative to a two-piece construction is to create a bottle having a so-called "champagne" base which resists the internal pressure. Inversion is a problem in such designs. In an attempt to avoid that problem, numerous bottle configurations have been proposed incorporating, for example, integral pressure-resistant ribs into the bottom of the bottle. Other prior art approaches are those disclosed in the inventor's own U.S. Pat. Nos. 4,780,257; 4,889,752; 4,927,679 which relate to a container having an annular peripheral chime surrounding an inward sloping base portion for resisting inversion of the base, caused by internal pressure, comprising an integral reinforcing ring incorporated into the base and running horizontally in the hoop direction. This reinforcing ring is placed in a location within the base to oppose inversion of the base.

More recently, bottle designs utilizing a petaloid base have been proposed. In all polyester (usually PET) bottles, weight is a very important consideration. Based on a conservative estimate of 5 billion bottles produced per year and a PET price of $(US) 1.54 per Kg ($(US) 0.70 per pound), a 1–2 gram decrease in the PET content of a bottle will save approximately $(US) 7–14 million per year.

OBJECT OF THE INVENTION

It is an object of the present invention to provide a construction for the base of a one piece plastic bottle for containing carbonated beverages which is of the petaloid type providing a larger support radius and/or using less material than prior art designs.

It is a further object of the present invention to provide a method for the blow molding of a light-weight one piece plastic bottle for containing carbonated beverages from a preform having a thickened annular region at the transition between its sidewall forming portion and its closed end.

SUMMARY OF THE INVENTION

According to the invention there is provided a blow molding process for producing a self-standing one-piece polyester container for carbonated beverages defining a longitudinal axis and comprising a sidewall portion which is integral with and terminates in a closed base of a petaloid form defining at least three feet disposed about the longitudinal axis whereby the container is self standing, each said foot being defined by a support pad and sloping walls extending therefrom to radially extending straps disposed between adjacent pairs of feet, each said strap extending from a gate area, centered on said longitudinal axis, along a curve toward an extended portion adjacent said side wall; and, a reinforcing ring located on said curve between said gate area and said extended portion and extending around said base through said feet, adjacent sloping walls and said straps, the method comprising the steps of a) forming a hollow preform comprising a sidewall forming portion of constant wall thickness material along the length thereof for forming a constant thickness sidewall portion of the container and terminating, at a transition, in a closed base forming portion, a reinforcing ring forming portion being located at the transition between the sidewall forming portion and the base forming portion, said reinforcing ring forming portion having a wall thickness greater than the wall thickness in the sidewall forming portion; b) temperature conditioning the preform; c) positioning the preform in a blow mold cavity defining the finished container shape and having a neck finish engaging top and a base forming bottom; d) inserting a stretch rod into the preform; e) extending the stretch rod within the cavity to move the bottom of the preform toward the bottom of the blow mold cavity to longitudinally stretch the material in at least the sidewall forming portion such that the preform extends from the top to adjacent the bottom of the blow mold cavity; and, f) injecting pressurized gas into the preform whereby the preform is radially stretched outwardly to fill the blow mold cavity and to form the container with the material of the reinforcing ring located to extend through said feet, adjacent sloping walls and said straps.

According to the invention there is also provided a self-standing polyester container for carbonated beverages defining a longitudinal axis and comprising a sidewall portion which is integral with and terminates in a closed base of a petaloid form defining at least three feet disposed about the longitudinal axis whereby the container is self standing, each said foot being defined by a support pad and sloping walls extending therefrom, said feet being disposed about said longitudinal axis, said base having radially extending straps disposed between adjacent pairs of feet, each said strap extending from a gate area, centered on said longitudinal axis, along a curve toward an extended portion adjacent said side wall; and, a reinforcing ring located on said curve between said gate and said extended portion and extending circumferentially around said base through said feet, adjacent sloping walls and said straps.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described, by way of example, with reference to the accompanying drawings, in which:

FIG. 1 is a partially sectioned view taken along line 1—1 of FIG. 2 of a prior art bottle having a petaloid base;

FIG. 2 is a bottom view of the petaloid base of a prior art bottle;

FIG. 3 is a section view of the base of the container of the present invention;

FIG. 4 is a section view of the base of the container of FIG. 3 showing an alternative embodiment of the present invention; and

FIG. 5 is a bottom view of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Briefly, the base of the preferred form of the container of the present invention comprises a petaloid design for a bottle which has a plurality of at least three (preferably five) feet evenly disposed around the longitudinal axis of the bottle and projecting from a hemispherical base form of the bottle to provide a stable self-standing support for the bottle. Between each adjacent pair of feet is a radially extending valley, the valley floor of which is preferably curved in cross-section. The valley floor generally follows the hemispherical base shape and opens to an extended portion of that base shape lying radially outwardly of the feet.

Referring first to FIGS. 1 and 2, a prior art one piece self-standing bi-axially oriented PET two liter bottle 1, of circular horizontal cross-section, comprises a neck finish 2 connected to a neck transition portion 3 by way of a neck support ring 4. The neck transition portion 3 connects by way of an upper portion 5 of the bottle to a substantially cylindrical sidewall portion 6 which terminates at its lower end in a closed base 7, the underlying shape of which is hemispherical. The bottle 1 defines a longitudinal axis 8.

Projecting downwardly from the hemispherical form of the base are five hollow feet 9 which together form a petaloid foot formation with the feet symmetrically and evenly disposed about the longitudinal axis 8 to provide the stable support for the bottle necessary to provide its self-standing ability. The lowest extensions of the feet 9 terminate in bottle support pads 10. Each foot 9 comprises sloping walls 11 extending from its pad 10 to its junction with the underlying hemispherical formation (reference numbers for sloping walls 11 are included in FIG. 2 only with respect to one of the feet although all of the feet are identical).

Radially extending valleys (or straps) 12 are disposed between adjacent pairs of feet 9. These straps 12 each include a valley floor which substantially follows the surface curvature of the underlying hemispherical shape of the base 7 and terminates at and open into an extended portion 13 where the straps 12 meets the sloping wall 11. Although shown in FIG. 2 by solid lines for simplicity at the junctions between the sloping walls 11 and the straps 12 and pads 10, the intersection of these elements are curved in cross-section to provide smooth transitions and structural rigidity of the straps along their length.

The gate area 14 of the base 7, through which extends the axis 8 is connected to each pad 10 by a substantially flat ridge path 15 joined on either side to portions of the sloping walls 11.

The bottle illustrated includes a small annular lip 16 which is primarily present for aesthetic purposes and for label alignment during production. This lip lies adjacent the transition from the sidewall 6 to the base 7.

As shown in FIG. 1, the transition from the extended portion 13 to the gate 14 is a smooth transition with increasing cross-sectional thickness. That is, the thickness at "D1" is less than the thickness at "A" which are both greater in thickness than the base of the present invention as will be discussed hereinafter.

With particular reference to FIGS. 1, 3 and 4 it will be noted that although the bottle is illustrated in cross-sectional form and although the material of the bottle will usually be substantially transparent, details of the interior of the bottle, lying beyond a cross-section taken are omitted for the sake of clarity in the illustration of the invention.

Turning now to FIG. 3, there is shown the petaloid base of the present invention. For convenience, like elements will be referred to with the same reference numerals as those used in FIGS. 1 and 2. FIG. 3 also shows, in cross-section, part of a monobase preform 18. The preform 18, injection molded polyester, typically PET (polyethylene terephthalate), is temperature conditioned and placed in a blow mold over and longitudinally stretched by a stretch rod 19. Pressurized gas is applied within the annular space 20 between the preform 18 and stretch rod 19 to push the walls of the preform 18 outwardly away from the axis 8 so as to expand the preform 18 into a desired finished shape in the blow mold which defines the exterior of that shape.

The preform comprises a neck finish 2, connected to a neck transition portion 3 by way of a neck support ring 4. A sidewall producing portion 22 of the preform extends from the neck transition portion 3 with a substantially constant outside diameter of 1.125 inches, however, both the inner 32 and outer 33 walls of the sidewall forming portion 22 are slightly tapered to facilitate release from the injection mold cavity and core. The thickness of the sidewall forming portion is about 0.145 inches. The sidewall forming portion 22 terminates in a closed base producing portion 23 having a wall thickness, in the gate producing area thereof, of 0.110 inches. The resulting preform 18 is similar in shape to a test tube. However, the transition (reinforcing ring forming portion 24) between the sidewall forming portion 22 and the bottom forming portion 23 has an increased wall thickness of about 0.160 inches. The purpose of the reinforcing ring forming portion 24 will be described hereinafter.

Prior to blow molding the preform 18 to produce the bottle 1, the preform 18 is temperature conditioned with preform 18 being turned about axis 8, during conditioning, so as to receive uniform heat. This temperature conditioning takes place outside the blow mold cavity immediately prior to being positioned in the mold cavity. For simplicity, the neck producing portion (which remains substantially the same) and the mold itself are not shown. The stretch rod 19, being extendable along the longitudinal axis, is pushed downward stretching the preform longitudinally until the bottom 29 of the preform 18 is closely adjacent (but spaced from) the bottom of the cavity. The reinforcing ring forming portion 24 has a wall thickness greater than both the wall thickness of the sidewall forming portion 22 and the bottom forming portion 23 and therefor the reinforcing ring forming portion 24 has a greater mass per unit area and is slightly cooler than the thinner portions of the preform. Due to this and the greater thickness more stretching occurs in the sidewall forming portion 22 and the gate area forming portion 23 than in the relatively cool thicker reinforcing ring forming portion 24. During blow molding, the stretch ratio between the wall thickness of the gate area forming portion 23 and the gate area 14 is about 2:1 whereas the stretch ratio between the sidewall forming portion 22 and the sloping wall 11 is about 12:1. In FIG. 3, the extension of the sidewall forming portion 22 by the stretch rod 19 occurs along axis 8 as shown by arrows 35 whereas arrows 36 show the

direction of extension in the bottom forming portion **23** by the stretch rod. The inside diameter of the preform **18** is greater than the outside diameter of the stretch rod **19** whereby an annular space **20** is provided. This space **20** facilitates pressurization of the preform **18** to produce the bottle **1**. Also, this space provides for a simply designed stretch rod having no step to accommodate the reinforcing ring forming portion **24** of the preform **18**.

Pressurized gas is then introduced within the preform **18** to blow the preform **18** outwardly and downwardly away from the stretch rod to produce the bottle **1**. The gas is introduced through the neck so that blow molding proceeds from the top of the bottle **1** adjacent the neck transition to the bottom forming portion **23**. The introduction of the gas may commence before the stretch rod has completed the longitudinal extension of the preform.

As is well known by those skilled in the art, preferred performance is obtained in PET containers by providing desired axial and hoop stretching of the material during the blow molding process thus biaxially orienting the material of the container. The above-described control of the temperature conditioning and the stretch rod operation coupled with the blow molding itself provide desired biaxial orientation of the container material together with accurate placement of the reinforcing ring forming portion **24** and gate area forming portion **23** to form the reinforcing petaloid base of the container.

Finally, according to the present invention, since the reinforcing ring forming portion **24** is cooler, material is pulled from bottom forming portion during blowing to increase the stretch and thus the orientation in the gate area **14**. This is believed at least in part because as the sidewall forming portion **22** is blown outwardly away from the stretch rod **19**, the gate area forming portion **23** is also blown outwardly and downwardly away from the stretch rod **19** while the slightly cooler more massive reinforcing ring forming portion **24** expands at a slower rate such that the reinforcing ring forming portion **24** is laid in the mold last, after the gate area has been formed. Thus, the gate area forming portion **23** is able to expand across the gate area with greater freedom than is available in the absence of the reinforcing ring forming portion **24**.

When the blowing is complete, container in the form of a bottle is produced having less weight than prior art petaloid based bottles while maintaining adequate strength to withstand internal pressure from a carbonated beverage. The base of the bottle comprises all of the features of the prior art bottles to facilitate standing. In addition, the base contains the reinforcing ring **21**, which defines the transition between an upper strap **38** and lower strap **39** of strap **12** as well as defines the transition between the sloping walls **11** and feet **9**.

The preferred preform design for a typical 2 liter bottle is one having the following:

sidewall forming portion **22** wall thickness=X

bottom forming portion **23** wall thickness=Y

reinforcing ring forming portion **24** wall thickness=Z

Y=from 0.6X to Z with a preferred range 0.7X to 0.8X

Z=from 1.03X to 1.33X with a preferred range from 1.05X to 1.10X

Prior art preforms blown into large or small contact diameters petaloid bases of 2 litter bottles generally have an outside diameter of the sidewall forming portion **22** of 1.125 inches. Typically wall thicknesses of the preform in this portion and at the transition to the base forming portion are:

large contact diameter preform=0.165 inches

small contact diameter preform=0.145 inches

large contact diameter base typically has a contact diameter of 3.2 inches (R=1.6 inches)

small contact diameter base typically has a contact diameter of 2.8 inches (R=1.4 inches)

Taking the diameter of mid-point of the preform wall thickness (example; 1.125–0.165=0.960) and dividing that number into the base contact diameter provides a stretch ratio for that point as follows.

large contact diameter=3.33=(3.2/(1.125–0.165))

small contact diameter =2.86 =(2.8/(1.125–0.145))

With the preform of the present invention, a thickened section **21** of material at the point needed in the bottle base, i.e. the foot is provided by the annular reinforcing ring forming portion **24** which is 0.160 inches thick. A typical contact diameter for the bottle of the present invention is about 3.0 inches (R=1.5 inches) thus yielding a stretch ratio in the hoop direction for the reinforcing ring of 3.11=3.0/(1.125–0.160)).

The wall reduction in the foot via hoop orientation only is determined by dividing the wall thickness by the stretch ratio which yields;

typical small contact dia 0.145/2.86=0.051

typical large contact dia 0.165/3.33=0.50

bottle bases of the present invention 0.160/3.11=0.052

As seen from the above, the bottle base of the present invention yields the thickest foot wall which gives more reinforcement at the foot as well as minimizing stress whitening which is an aesthetic defect. The stress whitening is caused by overstretching the material and is common to large contact diameter bottles.

The purpose of the reinforcing ring forming portion which forms the reinforcing ring blown into the bottle base provides several benefits. A one piece bottle needs to be self-standing and withstand the pressure from carbonation (which rises as the bottle is exposed temperatures above room temperature). The base will deform unacceptably if reinforcement is not provided in place of simply using more material. Strength is provided from three aspects; 1) geometric reinforcement of the base design, 2) material strength of the PET, 3) orientation strength imparted to the PET.

The preform used in the present invention has a thickened annular ring **24** to form a reinforcing ring **21** placed into those sections of the base which need reinforcement to permit a weight reduction the container base. Further, orientation of the bottom forming portion of the preform is increased to impart orientation strength in the gate area **14** of the bottle. This area is susceptible to stress cracking the risk of which can be reduced by increasing orientation.

The resulting base of the bottle of the present invention weighs 13.5 grams which is 1.5 grams less than the weight of the small contact diameter base (15 grams) while having a larger contact diameter (3.0 inches vs. 2.8 inches). The weight of the large contact diameter base is 17.5 grams. Thus significant material weight saving is achieved while contact diameter is increased relative to the prior art small contact diameter base and is 93% of that of the much, 4 gram, heavier prior art large contact diameter base.

Table 1 shows the comparison of bottle size, weight and wall thicknesses of prior art small contact diameter and large contact diameter bottles with the bottle of the present invention.

TABLE 1

Bottle	R (in)	Thickness (in) A	B	C	D1	D2	Base Weight (gm)
1	1.4	.087	.012	.011	.051	.015	15
2	1.4	.077	.010	.011	.035	.011	13.5
3	1.5	.060	.014	.012	.035	.013	13.5
4	1.6	.086	.009	.013	.043	.014	17.5

Bottle
1 Small diameter prior art base (15 grams)
2 Small diameter prior art base (13.5 grams)
3 Present invention monofoot base (13.5 grams)
4 Large diameter prior art base (17.5 grams)

In testing the prior art preform having the same base weight of the present invention (Bottle 2 in Table 1), it has been discovered that the wall thickness in D2 of 0.011 inches did not provide adequate structural strength to withstand the internal pressure generated by the carbonated beverage. Thus, without the redistribution of the material and the reinforcing ring of the present invention, merely reducing weight is insufficient to obtain a structurally sound bottle.

There are a number of significant advantages of the bottle of the present invention to prior art small contact diameter bottles. The first and most important is the reduction in weight of the base (from 15 grams to 13.5 grams) while having a larger base diameter (from 2.8 inches to 3.0 inches). Second, more material is provided in the foot 9 at "B"(from 0.008 to 0.14 inches thick) so that there exists less potential for stress whitening, thereby providing a more aesthetically pleasing bottle. This added material also provides a stronger foot. Third, the gate area **14** at "A" is thinner (from 0.087 inches to 0.060 inches) while maintaining adequate strength. As previously discussed, the thickness at "A" can be reduced because greater stretching occurs in bottom forming portion **23** to increase orientation thereby increasing strength coupled with lighter weight. Prior art bottles had less stretching in this area and thus required a greater thickness to maintain adequate strength and reduce stress cracking. Fourth, the amount of stretching during blowing at "D1" and "D2" is more than in the prior art bottles (compare Bottle 1 with Bottle 3). The redistribution of the material and the reinforcing ring allow this to occur without sacrificing bottle integrity.

The overall reduction in weight of the base from a prior art large contact diameter base (17.5 grams to 13.5 grams) while maintaining more than 93% of the contact diameter (3.0/3.2) is accomplished by placing the reinforcing ring **21** in areas of the base to provide the most resistance to deformation, i.e. the strap **12** and feet **9**, while reducing material thickness and increasing orientation in the gate area **14**.

It is preferable for changes in thickness in the preform to be gradual. It will be appreciated that the actual shape of the preform may differ from that illustrated herein providing the concepts set forth are followed. Further, it should be noted that the gate area forming portion could be as thick as the reinforcing ring forming portion.

In an alternative embodiment (FIG. 4), a monobase preform **18'** having an annular nub **26** is engaged by a mating annular groove **27** in the end of the stretch rod **19'**. This preform is of the type disclosed in the inventor's own U.S. Pat. Nos. (4,780,257; 4,889,752; and 4,927,679), which may be used in the present invention to provide a bottle with a petaloid base rather than a champagne base to which those patents relate. The resulting bottle will contain the reinforcing ring **21**, produced by the reinforcing ring forming portion **24'** and bottom forming portion **23'** of the preform **18'**.

Turning now to FIG. **5**, there is shown the bottom view of the base of the present invention showing the reinforcing ring **21** extending circumferentially around the base and following the curves and slopes through the straps **12** and sloping walls **11**.

What is claimed is:

1. A blow molding process for producing a self-standing one-piece polyester container for carbonated beverages defining a longitudinal axis and comprising a sidewall portion which is integral with and terminates in a closed base portion of a petaloid form defining at least three feet disposed about the longitudinal axis whereby the container is self standing, each said foot being defined by: i) a support pad; ii) a sloping outer wall extending generally upwardly from a radially outward extremity of the support pad to the sidewall portion; iii) sloping lateral walls extending generally upwardly from radially extending extremities of the support pad to radially extending straps disposed between adjacent pairs of feet, each said strap extending from a gate area, centered on said longitudinal axis, along a curve to said sidewall portion; iv) a sloping inner wall extending from a radially inner extremity of the support pad to the gate area; and, v) a reinforcing ring located on said curve between said gate area and said sidewall portion, in a transition between said support pad and said sloping outer wall, and extending circumferentially around said base portion through said feet, said lateral sloping walls and said straps, the method comprising the steps of:

a) forming a hollow preform comprising a sidewall forming portion of constant wall thickness material along the length of the sidewall forming portion, for forming a constant thickness sidewall portion of the container, and terminating, in a closed base forming portion, a reinforcing ring forming portion being located at a transition between the sidewall forming portion and the base forming portion, said reinforcing ring forming portion having a wall thickness greater than the wall thickness in the sidewall forming portion and greater than a wall thickness in the base forming portion;

b) temperature conditioning the preform;

c) positioning the preform in a blow mold cavity defining the finished container shape and having a neck finish engaging top and a base forming bottom;

d) inserting a stretch rod into the preform;

e) extending the stretch rod within the cavity to move the bottom of the preform toward the bottom of the blow mold cavity to longitudinally stretch the material in at least the sidewall forming portion such that the preform extends from the top to adjacent the bottom of the blow mold cavity; and,

f) injecting pressurized gas into the preform whereby the preform is radially stretched outwardly to fill the blow mold cavity to form the container with the material of the reinforcing ring located in the transitions between said support pads and said sloping outer walls, extending circumferentially around said base portion through said feet, said sloping lateral walls and said straps, and not extending radially inwardly through the feet to transitions between the sloping inner walls and the gate area, and the gate area and the transitions between the sloping inner walls and the gate area both having wall thicknesses that are less than the wall thicknesses in corresponding portions of the preform.

2. The method according to claim 1 further comprising the step of providing a reinforcing ring forming portion having a wall thickness in the range from about 1.03 to 1.33 times the thickness of said sidewall forming portion.

3. The method according to claim 2 wherein the step of forming the preform comprises the step of providing the base forming portion with a wall thickness in the range from about 0.6 times the thickness of said sidewall forming portion to about 1.0 times the thickness of said reinforcing ring forming portion.

4. The method according to claim 1 wherein the step of forming the preform comprises the step of providing the base forming portion with a wall thickness equal to or less than the thickness of the sidewall forming portion.

5. The method according to claim 1 wherein the step of forming the preform comprises the step of providing the base forming portion with a wall thickness approximately 0.6 to 0.8 times the thickness of the sidewall forming portion.

6. The method according to claim 5 wherein the step of forming the preform comprises the step of providing the base forming portion with a wall thickness about 0.7 to about 0.8 times the thickness of the sidewall forming portion.

7. The method according to claim 3 wherein the step of forming the preform comprises the step of providing the base forming portion with a wall thickness about 0.7 to about 0.8 times the thickness of the sidewall forming portion.

8. The method according to claim 1, wherein

the step of injecting pressurized gas into the preform comprises stretching the base forming portion of the preform, whereby the gate area has a wall thickness of about 0.06 inches.

9. The method according to claim 3, wherein

the step of injecting pressurized gas into the preform comprises stretching the base forming portion of the preform, whereby the gate area has a wall thickness of about 0.06 inches.

10. The method according to claim 1, wherein the step of forming the preform comprises forming the base forming portion with a wall thickness of about 0.11 inches, the reinforcing ring forming portion with a wall thickness of about 0.16 inches and the sidewall forming portion with a wall thickness of about 0.145 inches.

* * * * *

EXHIBIT E

US 20030031814A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2003/0031814 A1**

Hutchinson et al. (43) **Pub. Date: Feb. 13, 2003**

(54) **BOTTLES AND PREFORMS HAVING A CRYSTALLINE NECK**

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(21) Appl. No.: **09/844,820**

(22) Filed: **Apr. 27, 2001**

Related U.S. Application Data

(60) Provisional application No. 60/200,219, filed on Apr. 28, 2000.

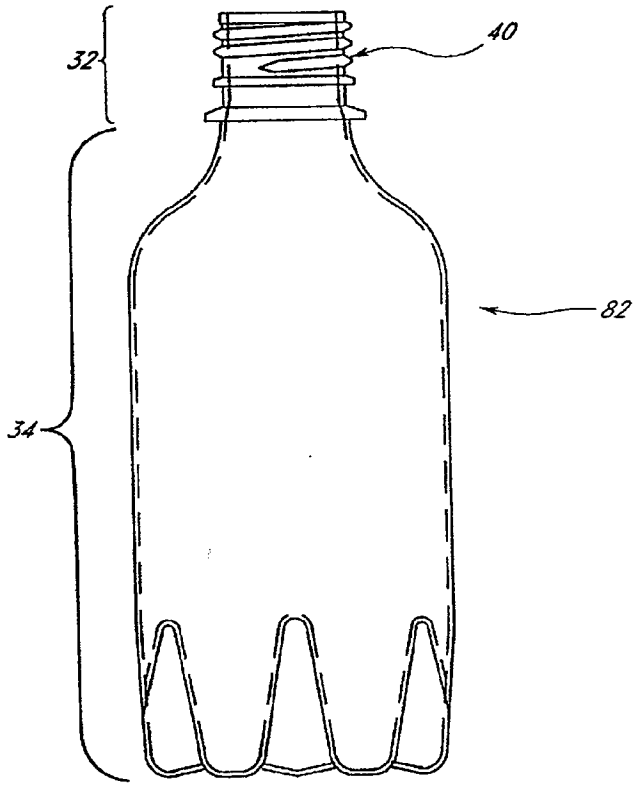
Publication Classification

(51) **Int. Cl.**[7] **B29C 49/06**; B29C 49/22; B29C 49/64

(52) **U.S. Cl.** **428/35.7**; 264/513; 264/255; 264/334; 425/526; 425/548

(57) **ABSTRACT**

Disclosed are plastic preforms and bottles, preferably comprising polyethylene terephthalate (PET), in which the materials in the neck, neck finish and/or neck cylinder is at least partially in the crystalline state and the body is primarily in the amorphous or semi-crystalline state. This structure in a preform enables the preform to be easily blow molded by virtue of the amorphous material in the body, while being able to have dimensional stability in hot-fill applications. In addition, the amorphous inner surface of the neck finish stabilizes the post mold dimensions allowing closer molding tolerances than other crystallizing processes. On the other side, the crystallized outer surface supports the amorphous structure during high temperature filling of the container. Physical properties are also enhanced as a result of this unique crystalline/amorphous structure.



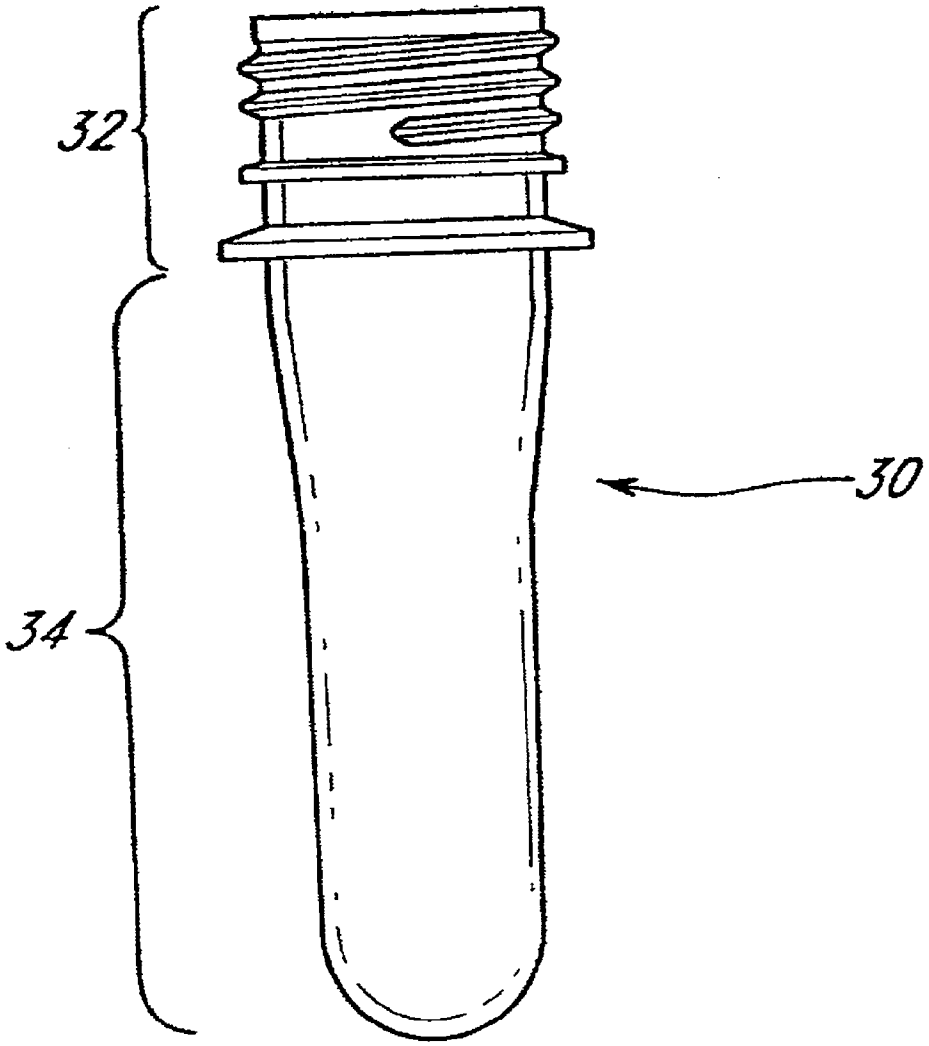


FIG. 2

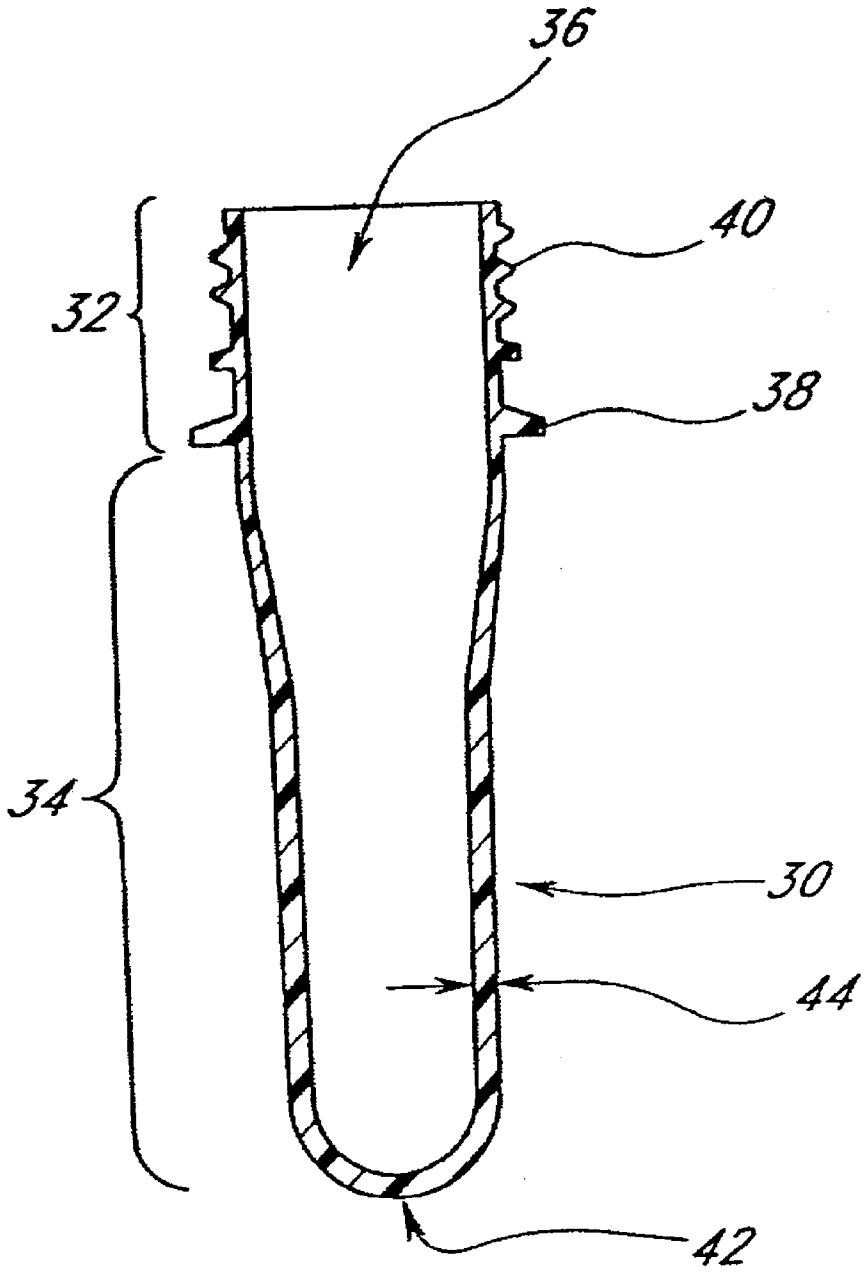
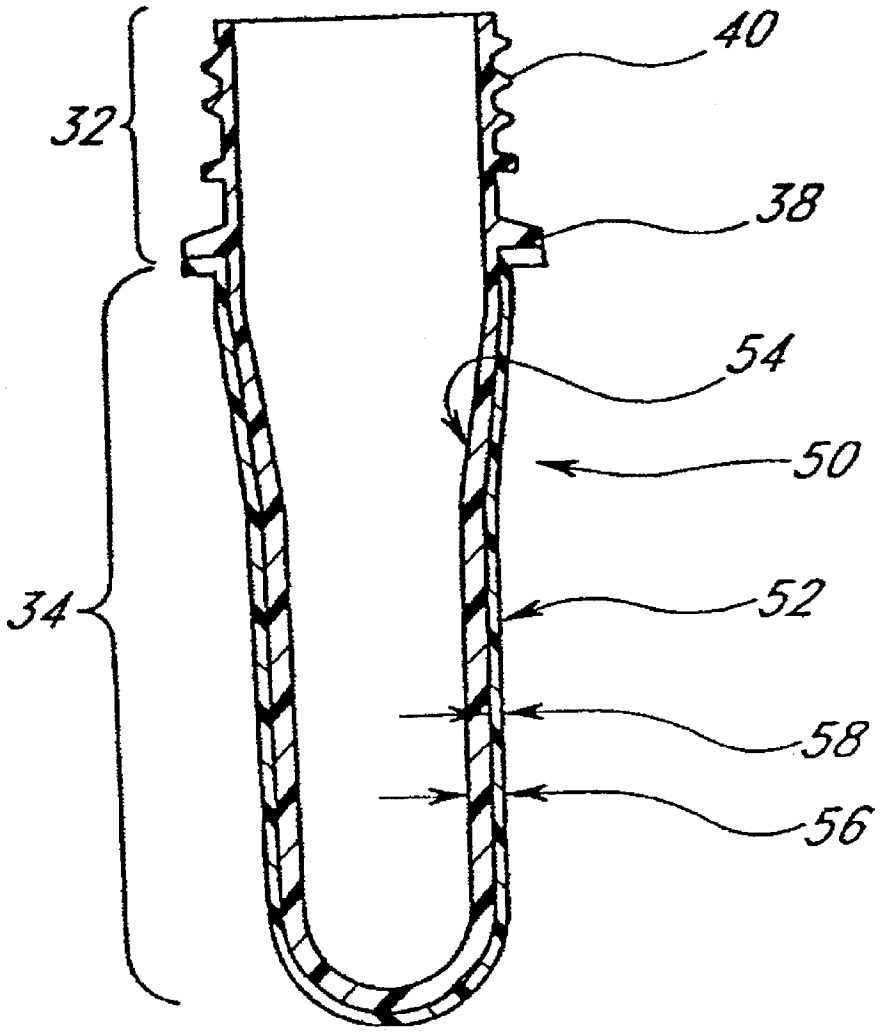


FIG. 2



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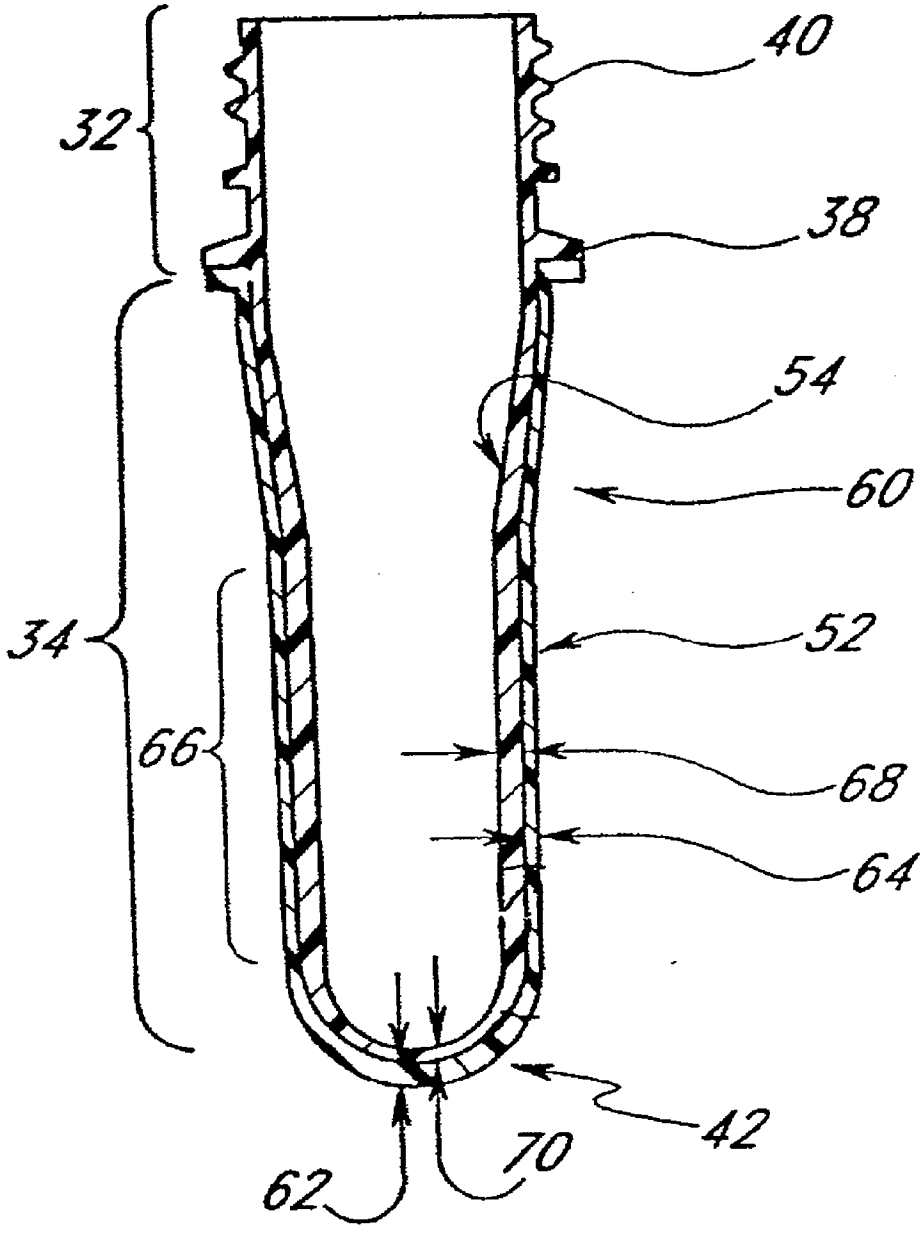


FIG. 4

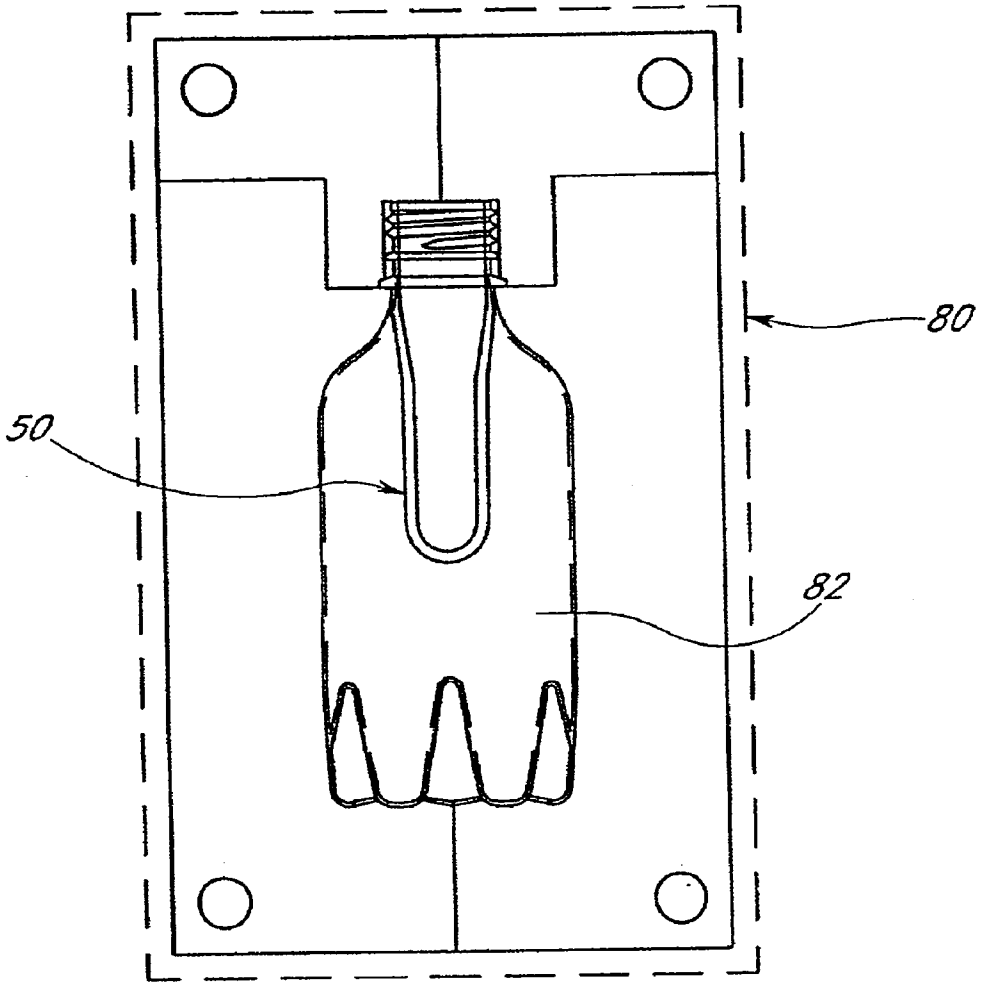
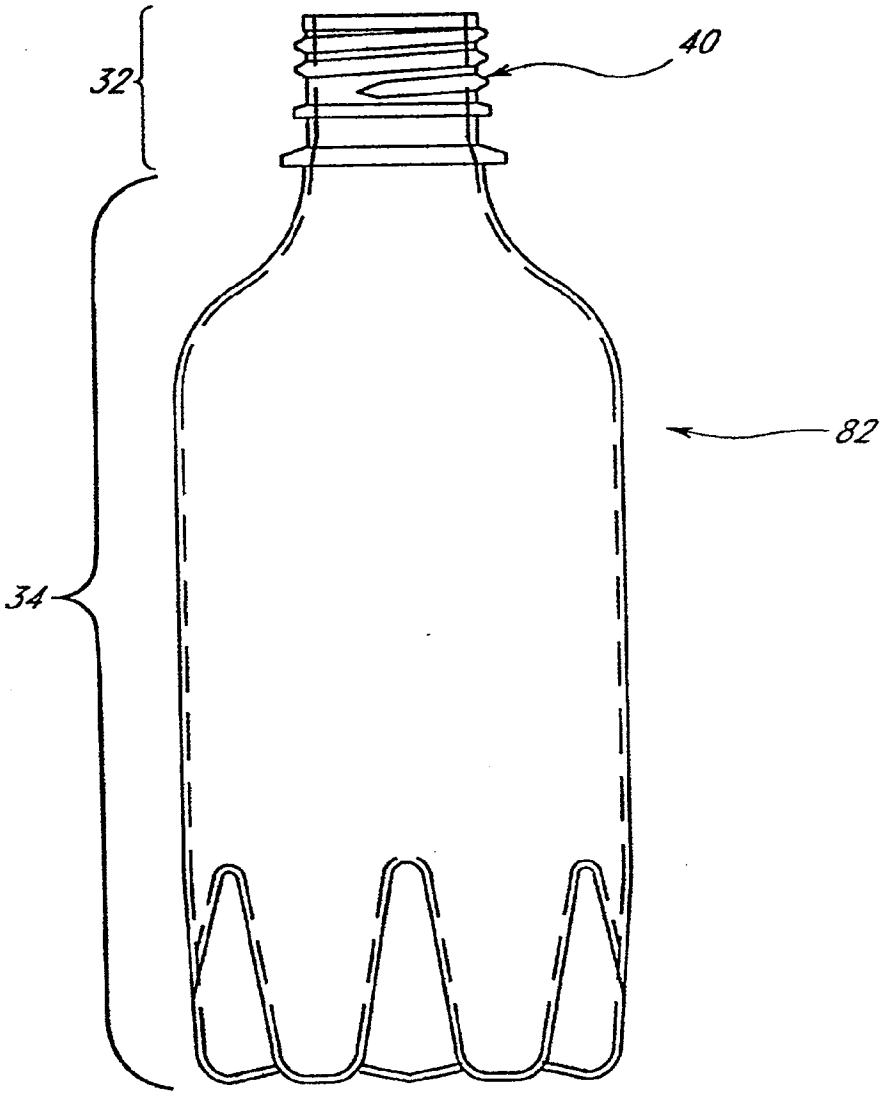


FIG. 5



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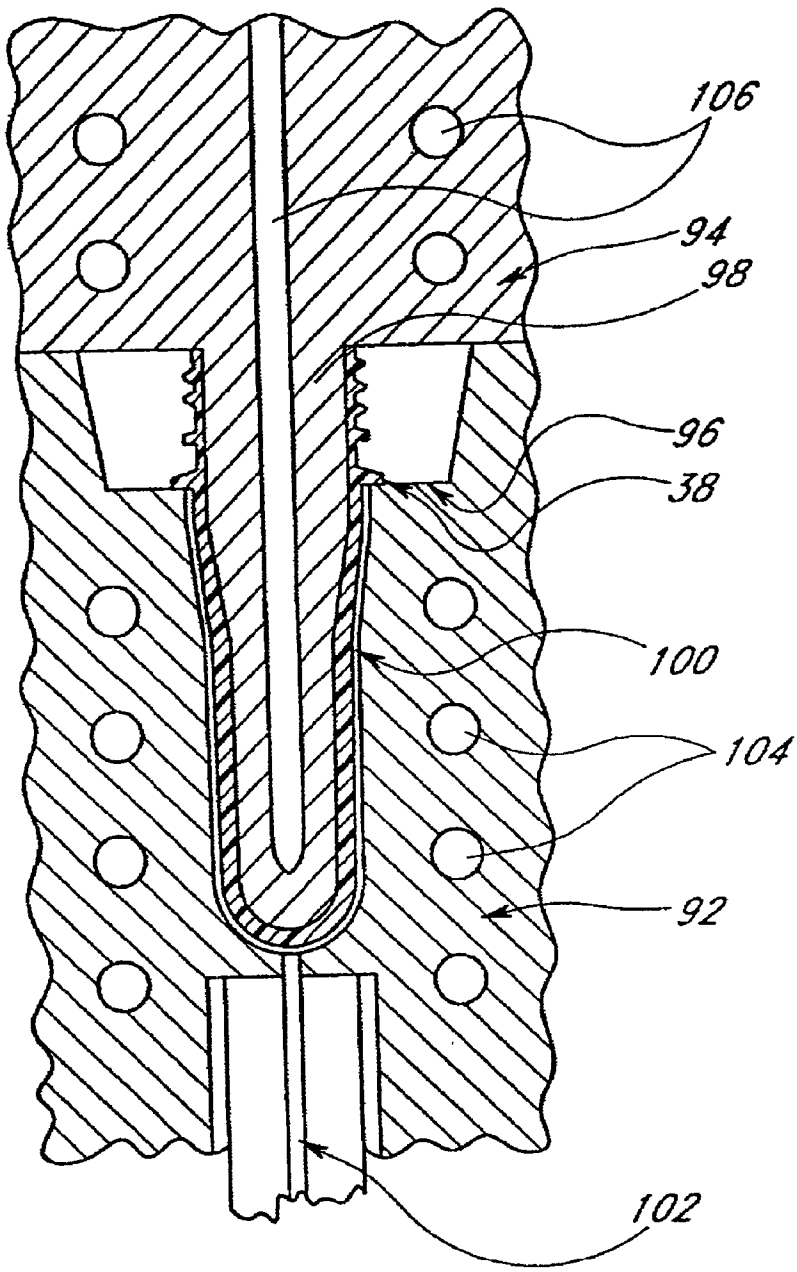

FIG. 7

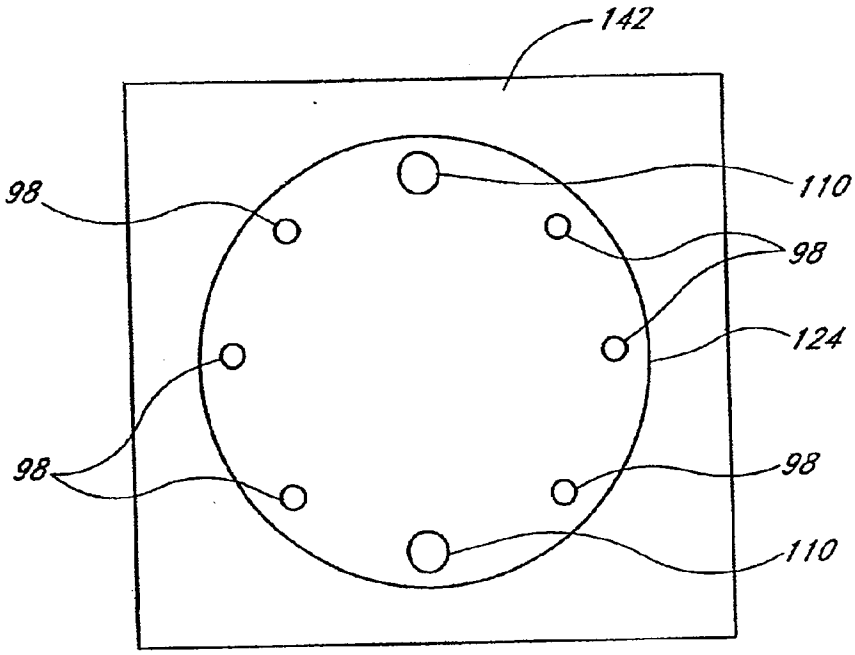
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FIG. 8

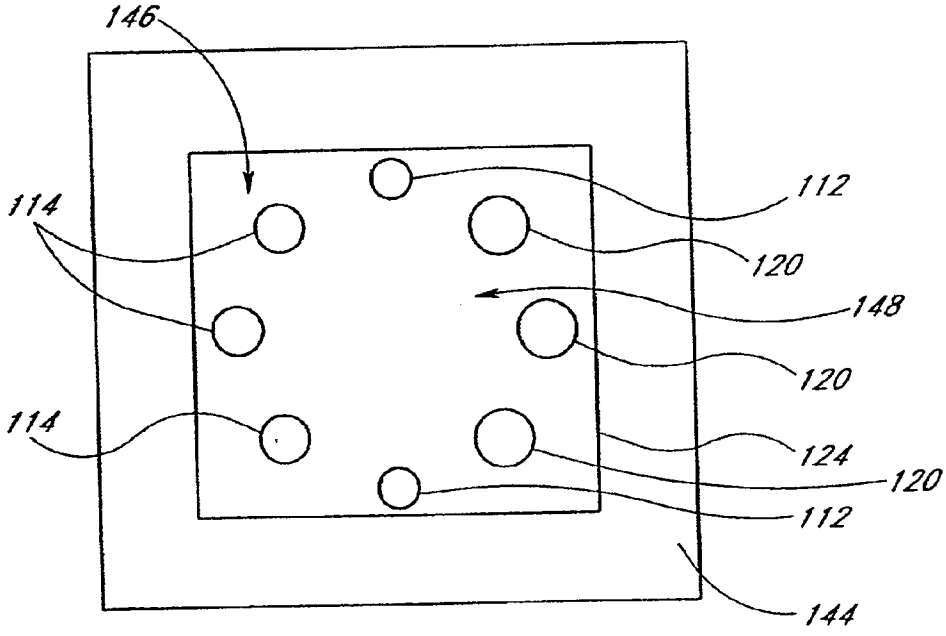
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FIG. 9

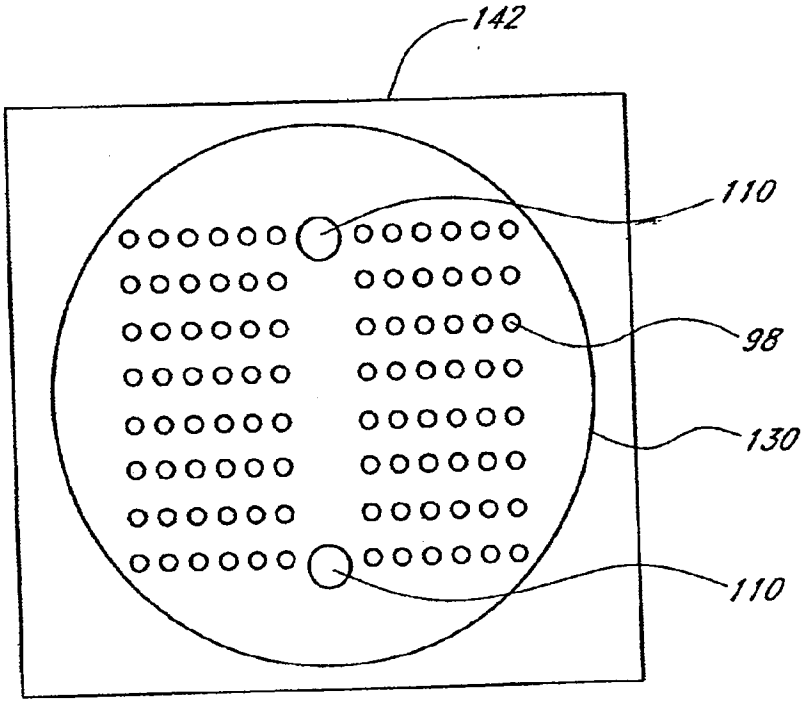
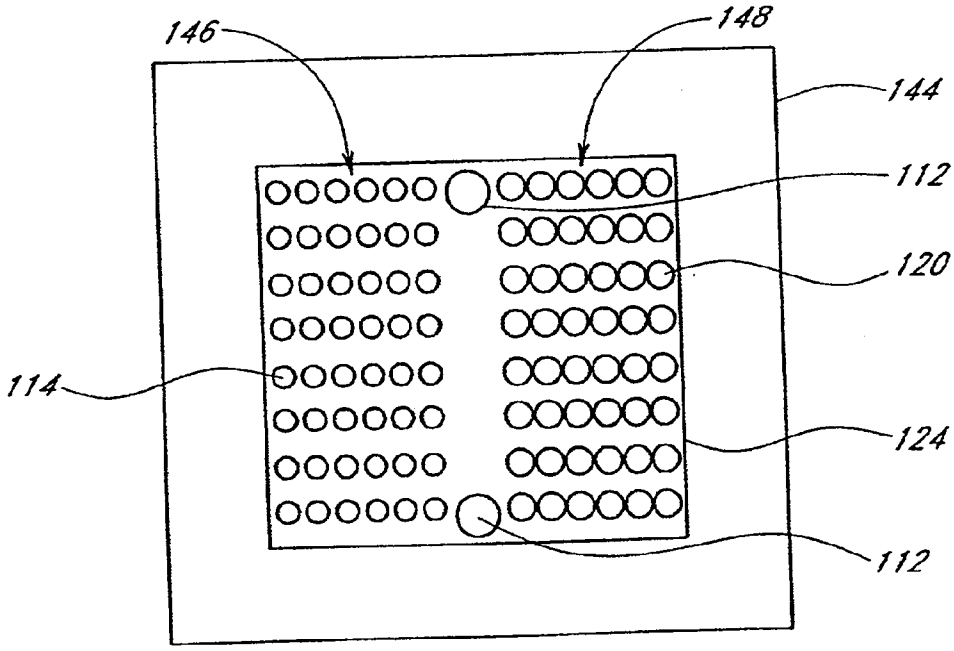


FIG. 10



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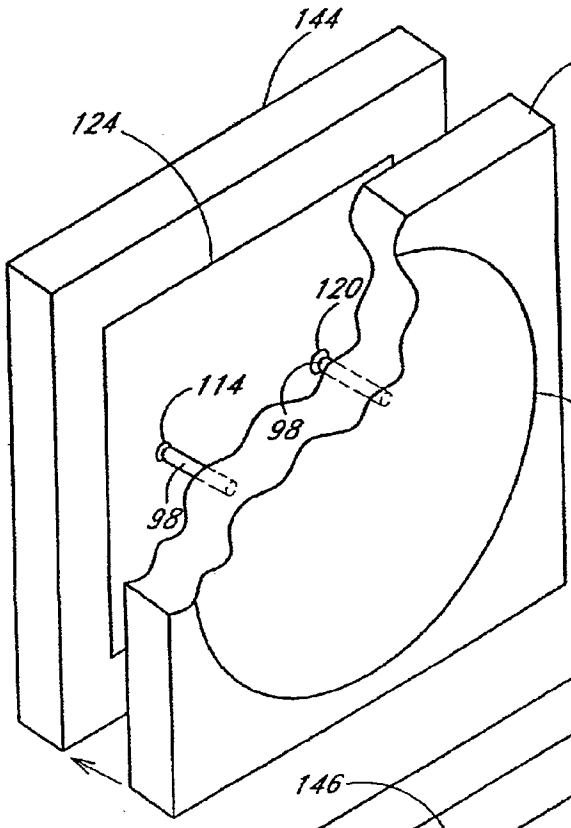
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FIG. 12

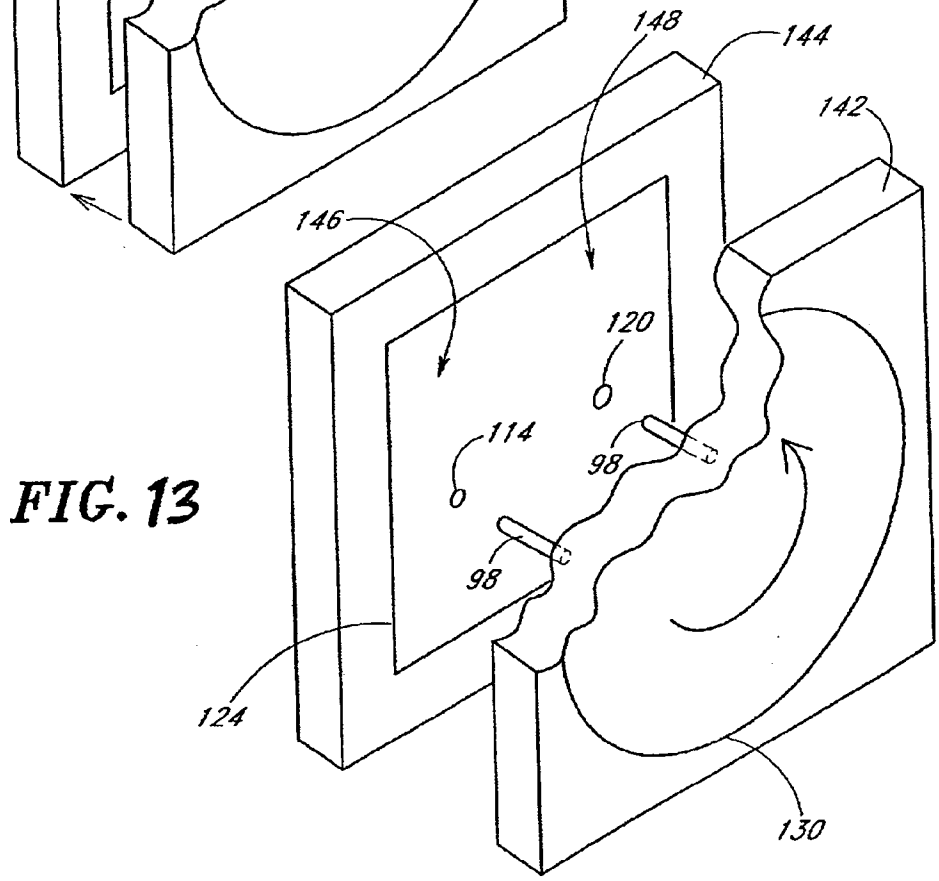
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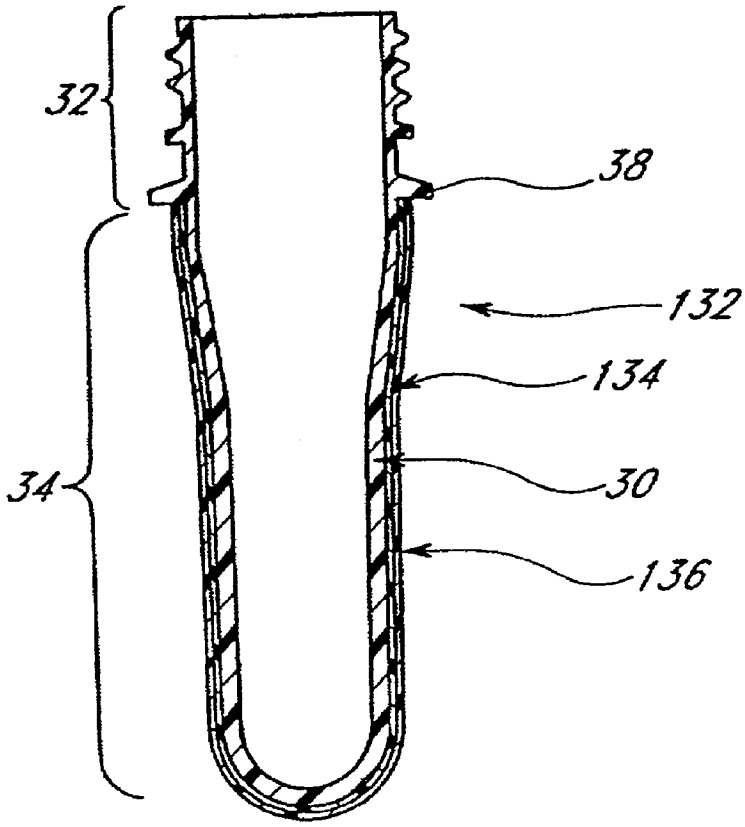
FIG. 13



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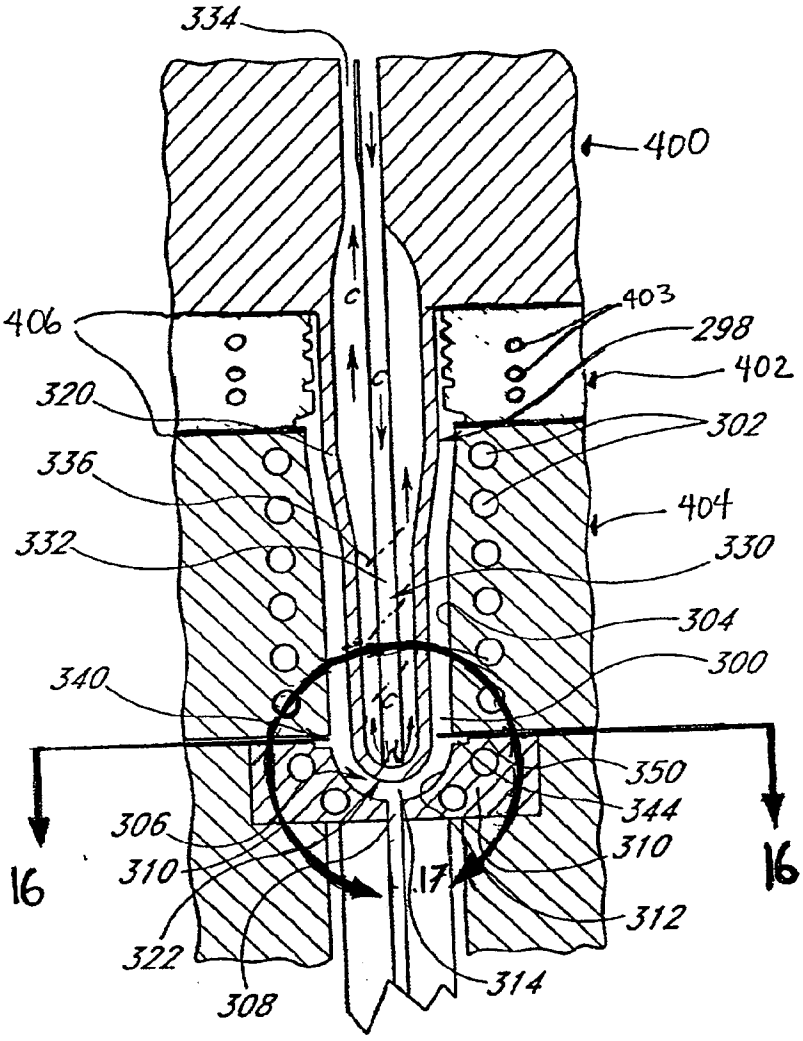
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FIG. 15

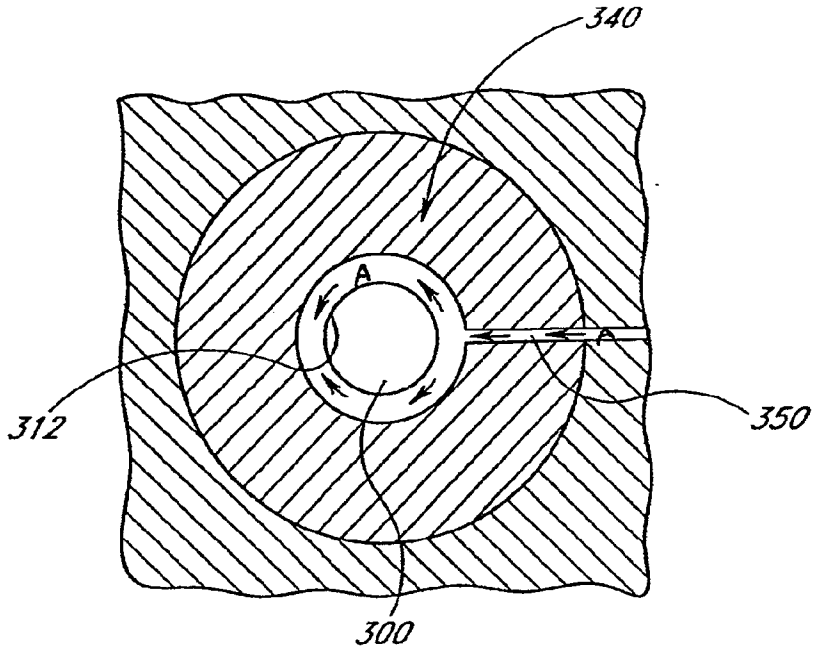

FIG. 16

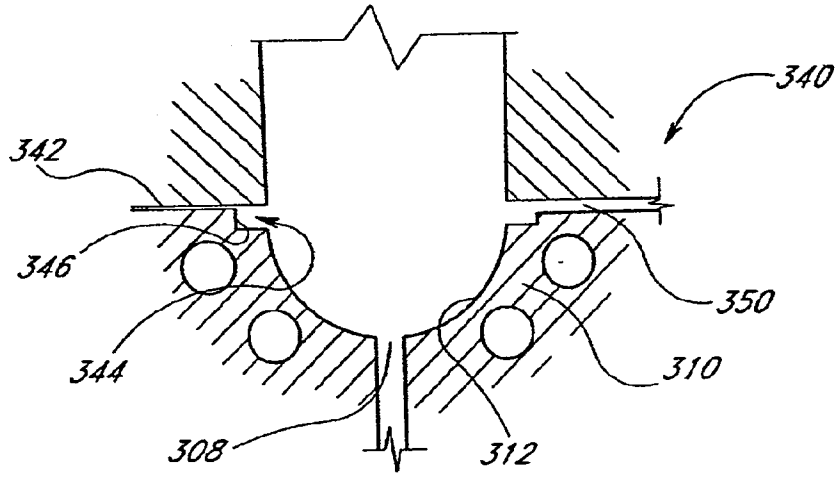

FIG. 17

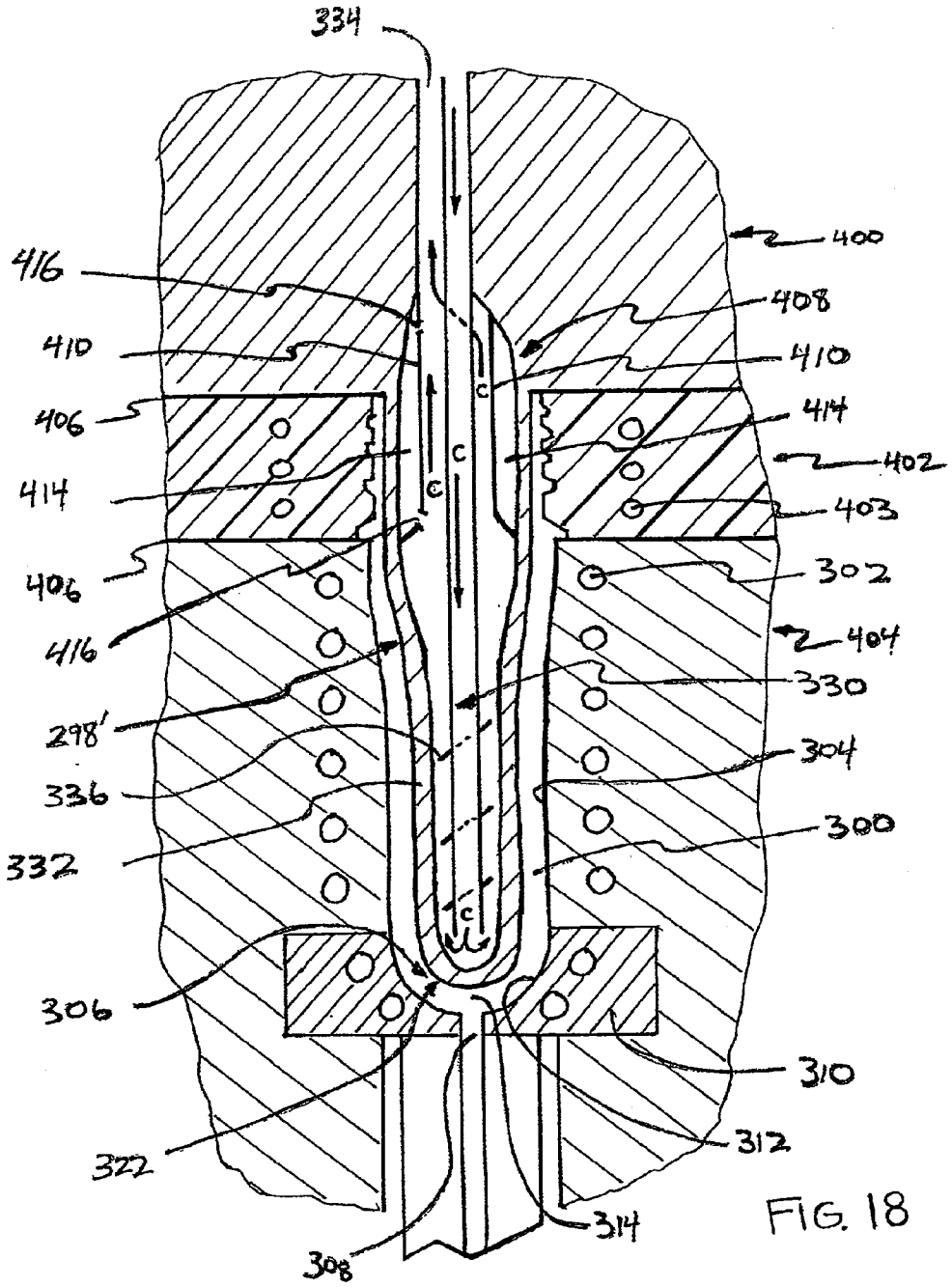
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FIG. 18

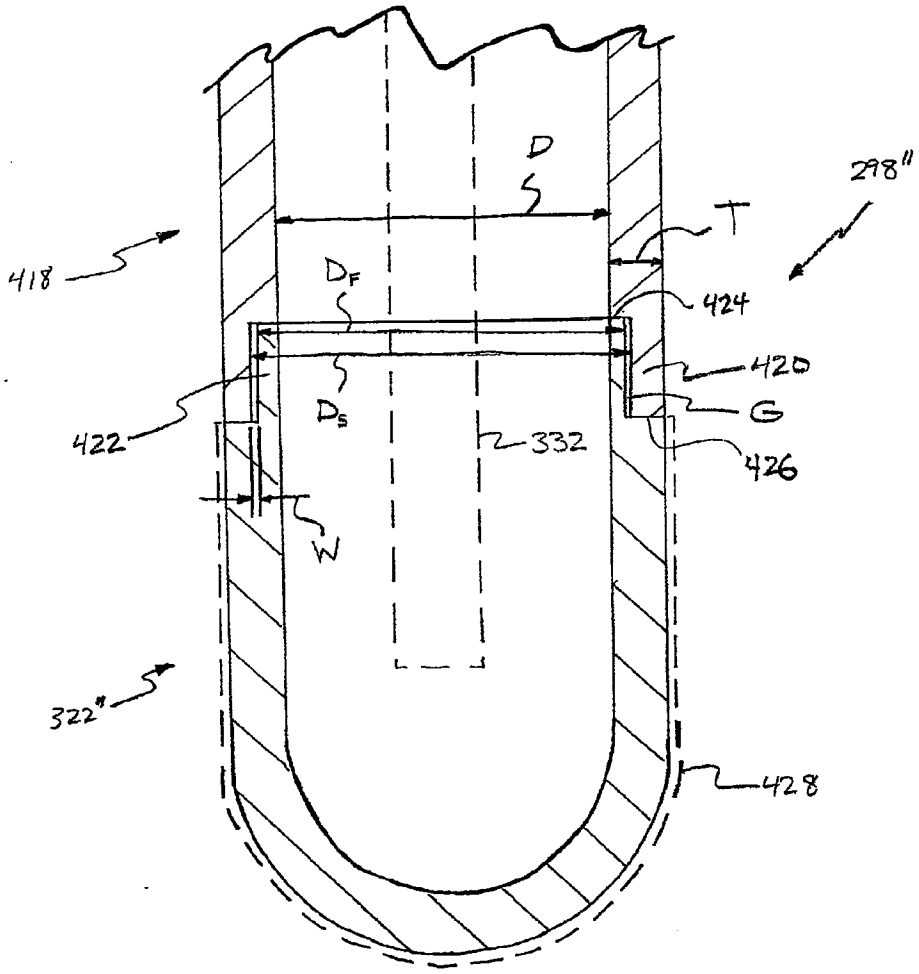


FIG. 19

BOTTLES AND PREFORMS HAVING A CRYSTALLINE NECK

PRIORITY INFORMATION

[0001] This application claims priority to U.S. Provisional Patent Application No. 60/200,219, filed Apr. 28, 2000, the entirety of which is incorporated by reference herein.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] This invention relates to plastic bottles and containers such as for containing beverages and the like. More specifically, this invention relates to plastic bottles, preferably comprising polyethylene terephthalate (PET), in which the materials in the neck, neck finish and/or neck cylinder is at least partially in the crystalline state. Such bottles and preforms also preferably comprise one or more layers comprising RPET, a material which acts as a barrier to oxygen and carbon dioxide, or an oxygen scavenger.

[0004] 2. Description of the Related Art

[0005] The use of plastic containers as a replacement for glass or metal containers in the packaging of beverages has become increasingly popular. The advantages of plastic packaging include lighter weight, decreased breakage as compared to glass, and potentially lower costs. The most common plastic used in making beverage containers today is PET. Virgin PET has been approved by the FDA for use in contact with foodstuffs. Containers made of PET are transparent, thin-walled, lightweight, and have the ability to maintain their shape by withstanding the force exerted on the walls of the container by pressurized contents, such as carbonated beverages. PET resins are also fairly inexpensive and easy to process.

[0006] Most PET bottles are made by a process which includes the blow-molding of plastic preforms which have been made by processes including injection molding. In some circumstances, it is preferred that the PET material in plastic preforms is in an amorphous or semi-crystalline state because materials in this state can be readily blow-molded where fully crystalline materials generally cannot. However, bottles made entirely of amorphous or semi-crystalline PET may not have enough dimensional stability during a standard hot-fill process due to the relatively low Tg of the PET material and the tight tolerances required when using standard threaded closures. In these circumstances, a bottle comprising crystalline PET would be preferred, as it would hold its shape during hot-fill processes.

SUMMARY OF THE INVENTION

[0007] In preferred embodiments, the present invention provides for a plastic bottle, which has the advantages of both a crystalline PET bottle and a amorphous or semi-crystalline PET bottle. By making at least part of the uppermost portion of the preform crystalline while keeping the body of the preform amorphous or semi-crystalline (sometimes referred to herein as "non-crystalline"), one can make a preform that will blow-mold easily yet retain necessary dimensions in the crucial neck area during a hot-fill process. The preform and bottle may be made solely of PET or another crystalline material, preferably a polyester, or it may further comprise other materials, including barrier materials and/or oxygen scavenger materials to prevent carbonated beverages or oxygen-sensitive products contained within the bottle from going "flat" or spoiling

[0008] Such processes preferably accomplish the making of a preform within the preferred cycle times for uncoated PET preforms of similar size by standard methods currently used in preform production. Further, the preferred processes are enabled by tooling design and process techniques to allow for the simultaneous production of crystalline and amorphous regions in particular locations on the same preform.

[0009] In accordance with a preferred embodiment, an article is provided which comprises a neck portion and a body portion. The neck portion and the body portion are a monolithic first layer of material. The body portion is primarily amorphous or semi-crystalline, and the neck portion is primarily crystalline.

[0010] In accordance with a preferred embodiment, there is provided a mold for making a preform comprising a neck portion having a first mold temperature control system, a body portion having a second temperature control system, and a core having a third temperature control system, wherein the first temperature control system is independent of the second and third temperature control systems and the neck portion is thermally isolated from the body portion and core.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] **FIG. 1** is an uncoated preform as is used as a starting material for preferred embodiments of the present invention.

[0012] **FIG. 2** is a cross-section of a preferred uncoated preform of the type that is barrier-coated in accordance with one preferred embodiment.

[0013] **FIG. 3** is a cross-section of one preferred embodiment of barrier-coated preform.

[0014] **FIG. 4** is a cross-section of another preferred embodiment of a barrier-coated preform.

[0015] **FIG. 5** is a cross-section of a preferred preform in the cavity of a blow-molding apparatus of a type that may be used to make a preferred barrier-coated container.

[0016] **FIG. 6** is one preferred embodiment of barrier-coated container.

[0017] **FIG. 7** is a cross-section of an injection mold of a type that may be used to make a preferred barrier-coated preform.

[0018] **FIGS. 8 and 9** are two halves of a molding machine to make barrier-coated preforms.

[0019] **FIGS. 10 and 11** are two halves of a molding machine to make forty-eight two-layer preforms.

[0020] **FIG. 12** is a perspective view of a schematic of a mold with mandrels partially located within the molding cavities.

[0021] **FIG. 13** is a perspective view of a mold with mandrels fully withdrawn from the molding cavities, prior to rotation.

[0022] **FIG. 14** is a three-layer embodiment of a preform.

[0023] **FIG. 15** is a cross-section of an injection mold of a type that may be used to make a preferred preform of the present invention;

[0024] **FIG. 16** is a cross-section of the mold of **FIG. 15** taken along lines 16-16;

[0025] **FIG. 17** is a cutaway close up view of the area of **FIG. 15** defined by line **17**;

[0026] **FIG. 18** is a cross-section of an injection mold core having a double wall neck finish portion;

[0027] **FIG. 19** is a cross-section of an enhanced injection mold core having a high heat transfer base end portion.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0028] The preferred embodiments described herein generally produce preforms with a crystalline neck, which are typically then blow-molded into beverage containers. The preforms may be monolayer; that is, comprised of a single layer of a base material, or they may be multilayer, including, but not limited to, those which comprise a combination of a base material and a barrier material and a combination of a base material and RPET. The material in such layers may be a single material or it may be a blend of one or more materials so as to include blends of polymers and/or inclusion of an oxygen scavenging material. The provision of one or more barrier layers, or the inclusion of an oxygen scavenger in one or more layers, is generally desirable when the container is to be filled with a carbonated beverage or oxygen sensitive product. The barrier layer serves to prevent the ingress of oxygen into the container or the egress of carbon dioxide from the container. Additionally, multiple barrier layers may be provided to refine barrier properties or provide desirable structural properties. For the sake of convenience, the barrier layer will be referred to in the singular, but is intended to include multiple barrier layers where appropriate and desired.

[0029] By achieving a crystallized state in the neck portion of the preform during the molding step, the final dimensions are substantially identical to the initial dimensions, unlike when additional heating steps are used. Therefore, dimensional variations are minimized and dimensional stability is achieved. This results in more consistent performance of the threads on the neck finish and reduces the scrape rate of the molding process.

[0030] The preferred embodiments generally have a monolithic, or unitary, first layer which has both crystalline and amorphous or semi-crystalline regions. This results in a preform which has sufficient strength to be used in widespread commercial applications. A preform which has a both crystalline and amorphous or semi-crystalline regions is shown in U.S. Pat. No. 6,217,818 to Collete et al. However, the preform of Collete et al. is constructed from a separately formed, crystalline neck portion. The neck portion is then placed into a second cavity which forms an amorphous body portion of the preform. However, this method has numerous drawbacks. For example, the arrangement of the pre-molded neck portion within the second, body forming, mold prevents venting of gases during the injection phase of the molding process. This would result in a void at the mechanical connection point between the neck and body portions and, thus, an insufficient connection. Additionally, the connection point between the neck and body portions is the last area of the mold cavity to receive injected material. As a result, there is poor flow of the melt at the point of the mold which forms the connection between the neck and body which would result in an insufficient mechanical connection between the two parts. Furthermore, the temperature of the injected material, or melt, is substantially low by the time it reaches the connection point, having travelled the full distance of the mold, that melt bonding would be minimal if it existed at all. Consequently, the method provided by Collette et al. is very unlikely to result in a commercially feasible preform, or container formed therefrom. Providing a monolithic first layer successfully overcomes the problems discussed above.

[0031] At least one of the preferred embodiments is provided with a barrier layer as described above. As such, the description may often refer to a barrier coated preform or finished bottle. References to barrier coated preform, however, should not give the impression that the present invention is confined only to multilayer preforms and containers which comprise a base layer of PET and a second layer or barrier coating; monolayer preforms comprised of homopolymers or copolymers of PET or other such crystalline polymers and polyesters, multilayer preforms having more than two layers, preforms having at least one layer comprising RPET, and other such permutations including the materials noted above may also be made to have the crystallized thread and/or neck components described herein.

[0032] Furthermore, the embodiments described herein specifically describe use of polyethylene terephthalate (PET) but many other thermoplastics, including those of the polyester type may also be used. Examples of such other materials include polyethylene naphthalate (PEN), PETG, polytetramethylene 1,2-dioxybenzoate, copolymers of ethylene terephthalate and ethylene isophthalate, and Polyamide Blends, and recycled materials, such as RPET.

[0033] In especially preferred embodiments, "high IPA PET" is used as the polyester which is barrier coated. As it is used herein, the term "high-IPA PET" refers to PET to which IPA was added during to manufacture to form a copolymer in which the IPA content is more than about 2% by weight, preferably 2-10% IPA by weight, more preferably 3-8%, most preferably about 4-5% IPA by weight. The most preferred range is based upon current FDA regulations, which do not allow for PET materials having an IPA content of more than 5% to be in contact with food or drink. If such regulations are not a concern, then an IPA content of 5-10% is preferred. As used herein, "PET" includes "high IPA PET."

[0034] The high-IPA PET (more than about 2% by weight) is preferred because the inventor has surprisingly discovered that use of high-IPA PET in the processes for making barrier preforms and containers, provides for better interlayer adhesion than is found in those laminates comprising PET with no IPA or low IPA. Additionally, it has been found that interlayer adhesion improves as the IPA content rises. Incorporation of the higher amounts of IPA into the PET results in a decrease in the rate of crystallization of the high IPA PET material as compared to PET homopolymer, or PET having lower amounts of IPA. The decrease in the rate of crystallization allows for the production of PET layers

(made of high IPA PET) having a lower level of crystallinity than what is achieved with low-IPA PET or homopolymer PET when they are made into barrier preforms by similar procedures. The lower crystallinity of the high-IPA PET is important in reducing crystallinity at the surface of the PET, i.e. the interface between the PET and the barrier material. Lower crystallinity allows for better adhesion between the layers and also provides for a more transparent container following blow molding of the preform.

[0035] While a non-crystalline preform is preferred for blow-molding, a bottle having greater crystalline character is preferred for its dimensional stability during a hot-fill process. Accordingly, a preform constructed according to preferred embodiments has a generally non-crystalline body portion and a generally crystalline neck portion. To create generally crystalline and generally non-crystalline portions in the same preform, one needs to achieve different levels of heating and/or cooling in the mold in the regions from which crystalline portions will be formed as compared to those in which generally non-crystalline portions will be formed. The different levels of heating and/or cooling are preferably maintained by thermal isolation of the regions having different temperatures. This thermal isolation between the thread split, core and/or cavity interface can be accomplished utilizing a combination of low and high thermal conduct materials as inserts or separate components at the mating surfaces of these portions.

[0036] The cooling of the mold in regions which form preform surfaces for which it is preferred that the material be generally amorphous or semi-crystalline, is accomplished by chilled fluid circulating through the mold cavity and core. In preferred embodiments, a mold set-up similar to conventional injection molding applications is used, except that there is an independent fluid circuit or electric heating system for the portions of the mold from which crystalline portions of the preform will be formed.

[0037] Preferably, the preforms and containers have the barrier coating disposed on their outer surfaces or within the wall of the container. In contrast with the technique of Slat, which produces multilayered preforms in which the layers are readily separated, in preferred embodiments disclosed herein the thermoplastic barrier material adheres directly and strongly to the PET surface and is not easily separated therefrom. Adhesion between the layers results without the use of any additional materials such as an adhesive material or a tie layer. The coated preforms are processed, preferably by stretch blow molding to form bottles using methods and conditions similar to those used for uncoated PET preforms. The containers which result are strong, resistant to creep, shrinkage and are cosmetically appealing as well as having good gas-barrier properties.

[0038] One or more layers of a barrier material are employed in carrying out the methods of and making the articles according to preferred embodiments. As used herein, the terms "barrier material", "barrier resin" and the like refer to materials which, when used to form articles, preferably have key physical properties similar to PET, adhere well to PET, and have a lower permeability to oxygen and carbon dioxide than PET.

[0039] Once a suitable barrier material is chosen, an apparatus and method for economically manufacturing a container using the barrier material is necessary. One important method and apparatus involves using an injection molding machine in conjunction with a mold comprising a mandrel or core and a cavity. A first layer of a preform is molded between the mandrel and a first cavity of the mold when a molten polyester is injected therein. The first layer remains on the mandrel when the mandrel is pulled out of the cavity, moved, and inserted into a second mold cavity. A second layer of the material, preferably a barrier layer or a layer comprising barrier material, is then injected over the existing first preform layer. The mandrel and accompanying preform are then removed from the second cavity and a robot removes the preform from the mandrel. While the robot cools the molded preform, the mandrel is available for another molding cycle.

[0040] A number of barrier materials having the requisite low permeability to gases such as oxygen and carbon dioxide are useful in preferred embodiments, the choice of barrier material being partly dependent upon the mode or application as described below. Preferred barrier materials for use in barrier coatings include those which fall into two major categories: (1) copolyesters of terephthalic acid, isophthalic acid, and at least one diol having good barrier properties as compared to PET, such as those disclosed in U.S. Pat. No. 4,578,295 to Jabarin, and which is commercially available as B-010 (Mitsui Petrochemical Ind. Ltd., Japan); and (2) hydroxy-functional poly(amide-ethers) such as those described in U.S. Pat. Nos. 5,089,588 and 5,143,998, poly(hydroxy amide ethers) such as those described in U.S. Pat. No. 5,134,218, polyethers such as those described in U.S. Pat. Nos. 5,115,075 and 5,218,075, hydroxy-functional polyethers such as those as described in U.S. Pat. No. 5,164,472, hydroxy-functional poly(ether sulfonamides) such as those described in U.S. Pat. No. 5,149,768, poly(hydroxy ester ethers) such as those described in U.S. Pat. No. 5,171,820, hydroxy-phenoxyether polymers such as those described in U.S. Pat. No. 5,814,373, and poly(hydroxyamino ethers) ("PHAE") such as those described in U.S. Pat. No. 5,275,853. The barrier materials described in (1) above are referred to herein by the term "Copolyester Barrier Materials". The compounds described in the patents in (2) above are collectively categorized and referred to herein by the term "Phenoxy-type Thermoplastic" materials. All the patents referenced in this paragraph are hereby incorporated in their entireties into this disclosure by this reference thereto.

[0041] Preferred Copolyester Barrier Materials have FDA approval. FDA approval allows for these materials to be used in containers where they are in contact with beverages and the like which are intended for human consumption. To the inventor's knowledge, none of the Phenoxy-type Thermoplastics have FDA approval as of the date of this disclosure. Thus, these materials are preferably used in multilayered containers in locations that do not directly contact the contents, if the contents are ingestible, or the mouth of the consumer when drinking from the container.

[0042] In carrying out preferred methods to form barrier coated preforms and bottles, an initial preform is coated with at least one additional layer of material comprising barrier material, polyesters such as PET, post-consumer or recycled PET (collectively recycled PET), and/or other compatible thermoplastic materials. A coating layer may comprise a single material, a mix or blend of materials (heterogeneous or homogeneous), an interwoven matrix of two or more

materials, or a plurality of microlayers (lamellae) comprised of at least two different materials. Initial preforms preferably comprise polyester, preferably virgin materials which are approved by the FDA for being in contact with foodstuffs.

[0043] Thus the preforms and containers according to preferred embodiments may exist in several forms, including, but not limited to: virgin PET coated with a layer of barrier material; virgin PET coated with a layer of material comprising alternating microlayers of barrier material and recycled PET; virgin PET coated with a barrier layer which is in turn coated with recycled PET; microlayers of virgin PET and a barrier material coated with a layer of recycled PET; virgin PET having an oxygen scavenger therein coated with recycled PET (RPET), virgin PET having an oxygen scavenger therein coated with recycled PET (RPET) which is coated with a layer of barrier material, or virgin PET coated with recycled PET which is then coated with barrier material. Other such variations and permutations of layer and material combinations are also within the scope of the disclosure and are presently contemplated.

[0044] As described previously, preferred barrier materials include Copolyester Barrier Materials and Phenoxy-type Thermoplastics. Other preferred barrier materials include polyamide barrier materials such as Nylon MXD-6 from Mitsubishi Gas Chemical (Japan). Other preferred barrier materials, referred to herein as "Polyamide Blends." Polyamide Blends as used herein shall include those polyamides containing PET or other polyesters, whether such polyester was included by blending, compounding or reacting. Other barrier materials having similar properties may be used in lieu of these barrier materials. For example, the barrier material may take the form of other thermoplastic polymers, such as acrylic resins including polyacrylonitrile polymers, acrylonitrile styrene copolymers, polyamides, polyethylene naphthalate (PEN), PEN copolymers, and PET/PEN blends.

[0045] Preferred barrier materials in accordance with embodiments of the present invention have oxygen and carbon dioxide permeabilities which are less than one-third those of polyethylene terephthalate. For example, the Copolyester Barrier Materials preferably exhibit a permeability to oxygen of about 11 cc mil/100 in^2 day and a permeability to carbon dioxide of about 2 cc mil/100 in^2 day. For certain PHAEs, the permeability to oxygen is less than 1 cc mil/100 in^2 day and the permeability to carbon dioxide is 3.9 cc mil/100 in^2 day. The corresponding CO_2 permeability of polyethylene terephthalate, whether in the recycled or virgin form, is about 12-20 cc mil/100 in^2 day.

[0046] For embodiments in which the container is heat set during or after blow-molding, it is preferred that the materials which form the container or article can exist in a form which is at least partially crystalline, more preferably primarily crystalline. Accordingly, for such embodiments, preferred barrier materials include PEN, Copolyesters, Polyamide Blends, and Phenoxy-type Thermoplastics which can exist in partially crystalline or primarily crystalline form.

[0047] The methods of preferred embodiments provide for a coating to be placed on a preform which is later blown into a bottle. In many cases, such methods are preferable to placing coatings on the bottles themselves. However, in accordance with other preferred embodiments, one or more coating layers may be placed on a bottle or container itself. Preforms are smaller in size and of a more regular shape than the containers blown therefrom, making it simpler to obtain an even and regular coating. Furthermore, bottles and containers of varying shapes and sizes can be made from preforms of similar size and shape. Thus, the same equipment and processing can be used to produce preforms to form several different kinds of containers. The blow-molding may take place soon after molding, or preforms may be made and stored for later blow-molding. If the preforms are stored prior to blow-molding, their smaller size allows them to take up less space in storage.

[0048] Even though it is preferable to form containers from coated preforms as opposed to coating containers themselves, they have generally not been used because of the difficulties involved in making containers from coated or multi-layer preforms. One step where the greatest difficulties arise is during the blow-molding process to form the container from the preform. During this process, defects such as delamination of the layers, cracking or crazing of the coating, uneven coating thickness, and discontinuous coating or voids can result. These difficulties can be overcome by using suitable barrier materials and coating the preforms in a manner that allows for good adhesion between the layers.

[0049] Thus, one aspect is the choice of a suitable barrier material, for those embodiments which include barrier materials. When a suitable barrier material is used, the coating sticks directly to the preform without any significant delamination, and will continue to stick as the preform is blow-molded into a bottle and afterwards. Use of a suitable barrier material also helps to decrease the incidence of cosmetic and structural defects which can result from blow-molding containers as described above.

[0050] It should be noted that although most of the discussion, drawings, and examples of making coated preforms deal with two layer preforms or bottles incorporating barrier layers, such discussion is not intended to limit the present invention to two layer barrier articles. The disclosure should be read to include, incorporate and describe articles having one or more layers, each layer of which is independently selected from the materials disclosed herein and materials similar thereto.

[0051] The two layer barrier containers and preforms according to preferred embodiments are suitable for many uses and are cost-effective because of the economy of materials and processing steps. However, in some circumstances and for some applications, preforms consisting of more than two layers may be desired. Use of three or more layers allows for incorporation of materials such as recycled PET, which is generally less expensive than virgin PET or the preferred barrier materials. Thus, it is contemplated that all of the methods for producing the barrier-coated preforms which are disclosed herein and all other suitable methods for making such preforms may be used, either alone or in combination to produce barrier-coated preforms and containers comprised of two or more layers.

[0052] In another aspect of the present invention, preforms and containers, including those which incorporate RPET, may be treated with additional external coatings through dip or spray processes. The materials dipped or sprayed upon the containers or preforms include, but are not limited to, solutions or dispersions of Phenoxy-type thermoplastics.

[0053] Referring to **FIG. 1**, a preferred uncoated preform **30** is depicted. The preform is preferably made of an FDA

approved material such as virgin PET and can be of any of a wide variety of shapes and sizes. The preform shown in **FIG. 1** is of the type which will form a 16 oz. carbonated beverage bottle that requires an oxygen and carbon dioxide barrier, but as will be understood by those skilled in the art, other preform configurations can be used depending upon the desired configuration, characteristics and use of the final article. The uncoated preform **30** may be made by injection molding as is known in the art or by methods disclosed herein.

[0054] Referring to **FIG. 2, a** cross-section of the preferred uncoated preform **30** of **FIG. 1** is depicted. The uncoated preform **30** has a neck portion **32** and a body portion **34**, formed monolithically (i.e., as a single, or unitary, structure). Advantageously, the monolithic arrangement of the preform, when blow-molded into a bottle, provides greater dimensional stability and improved physical properties in comparison to a preform constructed of separate neck and body portions, which are bonded together.

[0055] The neck portion **32** begins at the opening **36** to the interior of the preform **30** and extends to and includes the support ring **38**. The neck portion **32** is further characterized by the presence of the threads **40**, which provide a way to fasten a cap for the bottle produced from the preform **30**. The body portion **34** is an elongated and cylindrically shaped structure extending down from the neck portion **32** and culminating in the rounded end cap **42**. The preform thickness **44** will depend upon the overall length of the preform **30** and the wall thickness and overall size of the resulting container.

[0056] Referring to **FIG. 3, a** cross-section of one type of barrier-coated preform **50** having features in accordance with a preferred embodiment is disclosed. The barrier-coated preform **50** has a neck portion **32** and a body portion **34** as in the uncoated preform **30** in **FIGS. 1 and 2**. The barrier coating layer **52** is disposed about the entire surface of the body portion **34**, terminating at the bottom of the support ring **38**. A barrier coating layer **52** in the embodiment shown in the figure does not extend to the neck portion **32**, nor is it present on the interior surface **54** of the preform which is preferably made of an FDA approved material such as PET. The barrier coating layer **52** may comprise either a single material or several microlayers of at least two materials. The overall thickness **56** of the preform is equal to the thickness of the initial preform plus the thickness **58** of the barrier layer, and is dependent upon the overall size and desired coating thickness of the resulting container. By way of example, the wall of the bottom portion of the preform may have a thickness of 3.2 millimeters; the wall of the neck, a cross-sectional dimension of about 3 millimeters; and the barrier material applied to a thickness of about 0.3 millimeters.

[0057] Referring to **FIG. 4, a** preferred embodiment of a coated preform **60** is shown in cross-section. The primary difference between the coated preform **60** and the coated preform **50** in **FIG. 3** is the relative thickness of the two layers in the area of the end cap **42**. In coated preform **50**, the barrier layer **52** is generally thinner than the thickness of the initial preform throughout the entire body portion of the preform. In coated preform **60**, however, the barrier coating layer **52** is thicker at **62** near the end cap **42** than it is at **64** in the wall portion **66**, and conversely, the thickness of the inner polyester layer is greater at **68** in the wall portion **66** than it is at **70**, in the region of the end cap **42**. This preform design is especially useful when the barrier coating is applied to the initial preform in an overmolding process to make the coated preform, as described below, where it presents certain advantages including that relating to reducing molding cycle time. These advantages will be discussed in more detail below. The barrier coating layer **52** may be homogeneous or it may be comprised of a plurality of microlayers.

[0058] The barrier preforms and containers can have layers which have a wide variety of relative thicknesses. In view of the present disclosure, the thickness of a given layer and of the overall preform or container, whether at a given point or over the entire container, can be chosen to fit a coating process or a particular end use for the container. Furthermore, as discussed above in regard to the barrier coating layer in **FIG. 3**, the barrier coating layer in the preform and container embodiments disclosed herein may comprise a single material or several microlayers of two or more materials.

[0059] After a barrier-coated preform, such as that depicted in **FIG. 3**, is prepared by a method and apparatus such as those discussed in detail below, it is subjected to a stretch blow-molding process. Referring to **FIG. 5**, in this process a barrier-coated preform **50** is placed in a mold **80** having a cavity corresponding to the desired container shape. The barrier-coated preform is then heated and expanded by stretching and by air forced into the interior of the preform **50** to fill the cavity within the mold **80**, creating a barrier-coated container **82**. The blow molding operation normally is restricted to the body portion **34** of the preform with the neck portion **32** including the threads, pilfer ring, and support ring retaining the original configuration as in the preform.

[0060] Referring to **FIG. 6**, there is disclosed an embodiment of barrier coated container **82** in accordance with a preferred embodiment, such as that which might be made from blow molding the barrier coated preform **50** of **FIG. 3**. The container **82** has a neck portion **32** and a body portion **34** corresponding to the neck and body portions of the barrier-coated preform **50** of **FIG. 3**. The neck portion **32** is further characterized by the presence of the threads **40** which provide a way to fasten a cap onto the container.

[0061] The barrier coating **84** covers the exterior of the entire body portion **34** of the container **82**, stopping just below the support ring **38**. The interior surface **86** of the container, which is made of an FDA-approved material, preferably PET, remains uncoated so that only the interior surface **86** is in contact with beverages or foodstuffs. In one preferred embodiment that is used as a carbonated beverage container, the thickness **87** of the barrier coating is preferably 0.020-0.060 inch, more preferably 0.030-0.040 inch; the thickness **88** of the PET layer is preferably 0.080-0.160 inch, more preferably 0.100-0.140 inch; and the overall wall thickness **90** of the barrier-coated container **82** is preferably 0.140-0.180 inch, more preferably 0.150-0.170 inch. Preferably, on average, the overall wall thickness **90** of the container **82** derives the majority of its thickness from the inner PET layer.

[0062] **FIG. 7** illustrates a preferred type of mold for use in methods which utilize overmolding. The mold comprises

two halves, a cavity half **92** and a mandrel half **94**. The cavity half **92** comprises a cavity in which an uncoated preform is placed. The preform is held in place between the mandrel half **94**, which exerts pressure on the top of the preform and the ledge **96** of the cavity half **92** on which the support ring **38** rests. The neck portion **32** of the preform is thus sealed off from the body portion of the preform. Inside the preform is the mandrel **98**. As the preform sits in the mold, the body portion of the preform is completely surrounded by a void space **100**. The preform, thus positioned, acts as an interior die mandrel in the subsequent injection procedure, in which the melt of the overmolding material is injected through the gate **102** into the void space **100** to form the coating. The melt, as well as the uncoated preform, is cooled by fluid circulating within channels **104** and **106** in the two halves of the mold. Preferably the circulation in channels **104** is completely separate from the circulation in the channels **106**.

[0063] **FIGS. 8 and 9** are a schematic of a portion of the preferred type of apparatus to make coated preforms in accordance with a preferred embodiment. The apparatus is an injection molding system designed to make one or more uncoated preforms and subsequently coat the newly-made preforms by over-injection of a barrier material. **FIGS. 8 and 9** illustrate the two halves of the mold portion of the apparatus which will be in opposition in the molding machine. The alignment pegs **110** in **FIG. 8** fit into their corresponding receptacles **112** in the other half of the mold.

[0064] The mold half depicted in **FIG. 9** has several pairs of mold cavities, each cavity being similar to the mold cavity depicted in **FIG. 7**. The mold cavities are of two types: first injection preform molding cavities **114** and second injection preform coating cavities **120**. The two types of cavities are equal in number and are preferably arranged so that all cavities of one type are on the same side of the injection block **124** as bisected by the line between the alignment peg receptacles **112**. This way, every preform molding cavity **114** is 180° away from a preform coating cavity **120**.

[0065] The mold half depicted in **FIG. 8** has several mandrels **98**, one for each mold cavity (**114** and **120**). When the two halves which are **FIGS. 8 and 9** are put together, a mandrel **98** fits inside each cavity and serves as the mold for the interior of the preform for the preform molding cavities **114** and as a centering device for the uncoated preforms in preform coating cavities **120**. The mandrels **98** are mounted on a turntable **130** which rotates 180° about its center so that a mandrel **98** originally aligned with a preform molding cavity **114** will, after rotation, be aligned with a preform coating cavity **120**, and vice-versa. As described in greater detail below, this type of setup allows a preform to be molded and then coated in a two-step process using the same piece of equipment.

[0066] It should be noted that the drawings in **FIGS. 8 and 9** are merely illustrative. For instance, the drawings depict an apparatus having three molding cavities **114** and three coating cavities **120** (a 3/3 cavity machine). However, the machines may have any number of cavities, as long as there are equal numbers of molding and coating cavities, for example 12/12, 24/24, 48/48 and the like. The cavities may be arranged in any suitable manner. These and other minor alterations are contemplated as part of this disclosure.

[0067] The two mold halves depicted in **FIGS. 10 and 11** illustrate an embodiment of a mold of a 48/48 cavity machine as discussed for **FIGS. 8 and 9**. Referring to **FIG. 12** there is shown a perspective view of a mold of the type for an overmolding (inject-over-inject) process in which the mandrels **98** are partially located within the cavities **114** and **120**. The arrow shows the movement of the movable mold half **142**, on which the mandrels **98** lie, as the mold closes.

[0068] **FIG. 13** shows a perspective view of a mold of the type used in an overmolding process, wherein the mandrels **98** are fully withdrawn from the cavities **114** and **120**. The arrow indicates that the turntable **130** rotates 180° to move the mandrels **98** from one cavity to the next. On the stationary half **144**, the cooling for the preform molding cavity **114** is separate from the cooling for the preform coating cavity **120**. Both of these are separate from the cooling for the mandrels **98** in the movable half.

[0069] Referring to **FIG. 14** there is shown a preferred three-layer preform **132**. This embodiment of coated preform is preferably made by placing two coating layers **134** and **136** on a preform **30** such as that shown in **FIG. 1**.

[0070] With next reference to **FIG. 15**, a preferred embodiment of a mold mandrel **298** and associated cavity **300** are shown. Cooling tubes **302** are formed in a spiral fashion just below the surface **304** of the mold cavity **300**. A gate area **308** of the cavity **300** is defined near a gate **308** and an insert **310** of a material with especially high heat transfer properties is disposed in the cavity at the gate area **306**. Thus, the injected preform's gate area/base end **314** is cooled especially quickly.

[0071] The mandrel **298** is hollow and has a wall **320** of generally uniform thickness. A bubbler cooling arrangement **330** is disposed within the hollow mandrel **298** and comprises a core tube **332** located centrally within the mandrel **298** which delivers chilled coolant C directly to a base end **322** of the mandrel **298**. Coolant C works its way up the mandrel from the base end **322** and exits through an output line **334**. The core tube is held in place by ribs **336** extending between the tube and the mandrel wall **320**.

[0072] The body mold **404** has several cooling tubes **302** through which a chilled fluid, preferably water, is circulated. The neck finish mold **402** has several tubes **403** in which a fluid circulates. The fluid and circulation of tubes **403** and cooling tubes **302** are separate and independent. The coolant C circulating through the core section **400** is also separate from both tubes **403** and cooling tubes **302**. However, a single coolant source may provide the coolant C for both core section **400** and cooling tubes **302** within the body portion **404** of the mold.

[0073] The thermal isolation of the body mold **404**, neck finish mold **402** and core section **400** is achieved by use of inserts **406** having low thermal conductivity. However, materials having low thermal conductivity should not be used on the molding surfaces which contact the preform. Examples of preferred low thermal conductivity materials include heat-treated tool steel (e.g. P-20, H-13, Stainless etc.), polymeric inserts of filled polyamides, nomex, air gaps and minimum contact shut-off surfaces.

[0074] In this independent fluid circuit through tubes **403**, the fluid would be warmer than that used in the portions of the mold used to form non-crystalline portions of the preform. Preferred fluids include water, silicones, and oils. In another embodiment, the portions of the mold which forms

the crystalline portions of the preform, (corresponding to neck finish mold **402**) contains a heating apparatus placed in the neck, neck finish, and/or neck cylinder portions of the mold so as to maintain the higher temperature (slower cooling) needed to promote crystallinity of the material during cooling. Such a heating apparatus includes but is not limited to heating coils, heating probes, and electric heaters,

[0075] Referring also to **FIGS. 16 and 17**, an air insertion system **340** is shown formed at a joint **342** between members of the mold cavity **300**. A notch **344** is formed circumferentially around the cavity **300**. The notch **344** is sufficiently small that substantially no molten plastic will enter during melt injection. An air line **350** connects the notch **344** to a source of air pressure and a valve regulates the supply of air to the notch **344**. During melt injection, the valve is closed. When injection is complete, the valve is opened and pressurized air A is supplied to the notch **344** in order to defeat a vacuum that may form between an injected preform and the cavity wall **304**. Additionally, similar air insertion systems **340** may be utilized in other portions of the mold, such as the thread area, for example but without limitation.

[0076] The preferred method and apparatus for making barrier coated preforms is discussed in more detail below. Because the methods and apparatus are especially preferred for use in forming barrier coated bottles comprising certain preferred materials, the physical characteristics, identification, preparation and enhancement of the preferred materials is discussed prior to the preferred methods and apparatus for working with the materials.

[0077] A. Physical Characteristics of Preferred Barrier Materials

[0078] Preferred barrier materials preferably exhibit several physical characteristics which allow for the barrier coated bottles and articles according to preferred embodiments to be able to withstand processing and physical stresses in a manner similar or superior to that of uncoated PET articles, in addition to producing articles which are cosmetically appealing and have excellent barrier properties.

[0079] Adhesion is the union or sticking together of two surfaces. The actual interfacial adhesion is a phenomenon which occurs at the microscopic level. It is based upon molecular interactions and depends upon chemical bonding, van der Waals forces and other intermolecular attractive forces at the molecular level.

[0080] Good adhesion between the barrier layer and the PET layer is especially important when the article is a barrier bottle made by blow-molding a preform. If the materials adhere well, then they will act as one unit when they are subjected to a blow molding process and as they are subjected to stresses when existing in the form of a container. Where the adhesion is poor, delamination results either over time or under physical stress such as squeezing the container or the container jostling during shipment. Delamination is not only unattractive from a commercial standpoint, it may be evidence of a lack of structural integrity of the container. Furthermore, good adhesion means that the layers will stay in close contact when the container is expanded during the molding process and will move as one unit. When the two materials act in such a manner, it is less likely that there will be voids in the coating, thus allowing a thinner coating to be applied. The barrier materials preferably adhere sufficiently to PET such that the barrier layer cannot be easily pulled apart from the PET layer at 22° C.

[0081] The glass transition temperature (Tg) is defined as the temperature at which a non-crystallizable polymer undergoes the transformation from a soft rubber state to a hard elastic polymer glass. In a range of temperatures above its Tg, a material will become soft enough to allow it to flow readily when subjected to an external force or pressure, yet not so soft that its viscosity is so low that it acts more like a liquid than a pliable solid. The temperature range above Tg is the preferred temperature range for performing a blow-molding process, as the material is soft enough to flow under the force of the air blown into the preform to fit the mold but not so soft that it breaks up or becomes uneven in texture. Thus, when materials have similar glass transition temperatures, they will have similar preferred blowing temperature ranges, allowing the materials to be processed together without compromising the performance of either material.

[0082] In the blow-molding process to produce bottle from a preform, as is known in the art, the preform is heated to a temperature slightly above the Tg of the preform material so that when air is forced into the preform's interior, it will be able to flow to fill the mold in which it is placed. If one does not sufficiently heat the preform and uses a temperature below the Tg, the preform material will be too hard to flow properly, and would likely crack, craze, or not expand to fill the mold. Conversely, if one heats the preform to a temperature well above the Tg, the material would likely become so soft that it would not be able to hold its shape and would process improperly.

[0083] If a barrier coating material has a Tg similar to that of PET, it will have a blowing temperature range similar to PET. Thus, if a PET preform is coated with such a barrier material, a blowing temperature can be chosen that allows both materials to be processed within their preferred blowing temperature ranges. If the barrier coating were to have a Tg dissimilar to that of PET, it would be difficult, if not impossible, to choose a blowing temperature suitable for both materials. When the barrier coating materials have a Tg similar to PET, the coated preform behaves during blow molding as if it were made of one material, expanding smoothly and creating a cosmetically appealing container with an even thickness and uniform coating of the barrier material where it is applied.

[0084] The glass transition temperature of PET occurs in a window of about 75-85° C., depending upon how the PET has been processed previously. The Tg for preferred barrier materials is preferably 55 to 140° C., more preferably 90 to 110° C.

[0085] Another factor which has an impact on the performance of barrier preforms during blow molding is the state of the material. The preferred barrier materials of preferred embodiments are amorphous rather than crystalline. This is because materials in an amorphous state are easier to form into bottles and containers by use of a blow molding process than materials in a crystalline state. PET can exist in both crystalline and amorphous forms. However, in preferred embodiments it is highly preferred that the crystallinity of the PET be minimized and the amorphous state maximized in order to create a semi-crystalline state which, among other things, aids interlayer adhesion and in the blow molding process. A PET article formed from a melt of PET, as in

injection molding, can be guided into a semi-crystalline form by cooling the melt at a high rate, fast enough to quench the crystallization process, freezing the PET in a mostly amorphous state. Additionally, use of "high IPA PET" as described earlier herein will allow easier quenching of the crystallization process because it crystallizes at a lower rate than homopolymer PET.

[0086] Intrinsic viscosity and melt index are two properties which are related to a polymer's molecular weight. These properties give an indication as to how materials will act under various processing conditions, such as injection molding and blow molding processes.

[0087] Barrier materials for use in the articles and methods according to preferred embodiments have an intrinsic viscosity of preferably 0.70-0.90 dl/g, more preferably 0.74-0.87 dl/g, most preferably 0.84-0.85 dl/g and a melt index of preferably 5-30, more preferably 7-12, most preferably 10.

[0088] Barrier materials preferably have tensile strength and creep resistance similar to PET. Similarity in these physical properties allows the barrier coating to act as more than simply a gas barrier. A barrier coating having physical properties similar to PET acts as a structural component of the container, allowing the barrier material to displace some of the polyethylene terephthalate in the container without sacrificing container performance. Displacement of PET allows for the resulting barrier-coated containers to have physical performance and characteristics similar to their uncoated counterparts without a substantial change in weight or size. It also allows for any additional cost from adding the barrier material to be defrayed by a reduction in the cost per container attributed to PET.

[0089] Similarity in tensile strength between PET and the barrier coating materials helps the container to have structural integrity. This is especially important if some PET is displaced by barrier material. Barrier-coated bottles and containers having features in accordance with preferred embodiments are able to withstand the same physical forces as an uncoated container, allowing, for example, barrier-coated containers to be shipped and handled in the customary manner of handling uncoated PET containers. If the barrier-coating material were to have a tensile strength substantially lower than that of PET, a container having some PET displaced by barrier material would likely not be able to withstand the same forces as an uncoated container.

[0090] Similarity in creep resistance between PET and the barrier coating materials helps the container to retain its shape. Creep resistance relates to the ability of a material to resist changing its shape in response to an applied force. For example, a bottle which holds a carbonated liquid needs to be able to resist the pressure of dissolved gas pushing outward and retain its original shape. If the barrier coating material were to have a substantially lower resistance to creep than PET in a container, the resulting container would be more likely to deform over time, reducing the shelf-life of the product.

[0091] For applications where optical clarity is of importance, preferred barrier materials have an index of refraction similar to that of PET. When the refractive index of the PET and the barrier coating material are similar, the preforms and, perhaps more importantly, the containers blown therefrom are optically clear and, thus, cosmetically appealing for use as a beverage container where clarity of the bottle is frequently desired. If, however, the two materials have substantially dissimilar refractive indices when they are placed in contact with each other, the resulting combination will have visual distortions and may be cloudy or opaque, depending upon the degree of difference in the refractive indices of the materials.

[0092] Polyethylene terephthalate has an index of refraction for visible light within the range of about 1.40 to 1.75, depending upon its physical configuration. When made into preforms, the refractive index is preferably within the range of about 1.55 to 1.75, and more preferably in the range of 1.55-1.65. After the preform is made into a bottle, the wall of the final product, may be characterized as a biaxially-oriented film since it is subject to both hoop and axial stresses in the blow molding operation. Blow molded PET generally exhibits a refractive index within the range of about 1.40 to 1.75, usually about 1.55 to 1.75, depending upon the stretch ratio involved in the blow molding operation. For relatively low stretch ratios of about 6:1, the refractive index will be near the lower end, whereas for high stretch ratios, about 10:1, the refractive index will be near the upper end of the aforementioned range. It will be recognized that the stretch ratios referred to herein are biaxial stretch ratios resulting from and include the product of the hoop stretch ratio and the axial stretch ratio. For example, in a blow molding operation in which the final preform is enlarged by a factor of 2.5 in the axial direction and a factor of 3.5 diametrically, the stretch ratio will be about 8.75 (2.5×3.5).

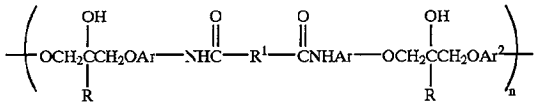
[0093] Using the designation n_i to indicate the refractive index for PET and n_o to indicate the refractive index for the barrier material, the ratio between the values n_i and n_o is preferably 0.8-1.3, more preferably 1.0-1.2, most preferably 1.0-1.1. As will be recognized by those skilled in the art, for the ratio $n_i/n_o=1$ the distortion due to refractive index will be at a minimum, because the two indices are identical. As the ratio progressively varies from one, however, the distortion increases progressively.

[0094] B. Preferred Barrier Coating Materials and Their Preparation

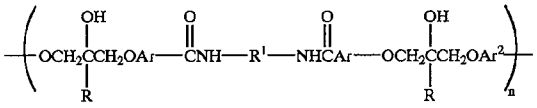
[0095] The preferred barrier coating materials for use in the articles and methods described herein include Phenoxy-type Thermoplastic materials, copolyesters of terephthalic acid, isophthalic acid, and at least one diol having good barrier properties as compared to PET (Copolyester Barrier Materials), polyamides, Polyamide Blends, PEN, PEN copolymers, PEN/PET blends, and combinations thereof. Preferably, the Phenoxy-type Thermoplastics used as barrier materials are one of the following types:

[0096] hydroxy-functional poly(amide ethers) having repeating units represented by any one of the Formulae Ia, Ib or Ic:

Ia

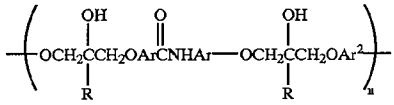


Ib



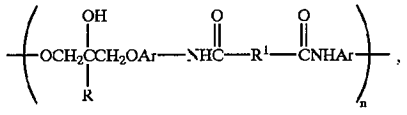
or

Ic

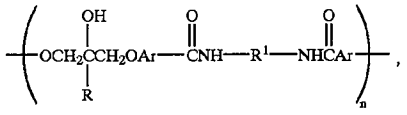


[0097] poly(hydroxy amide ethers) having repeating units represented independently by any one of the Formulae IIa, IIb or IIc:

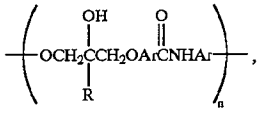
IIa



IIb

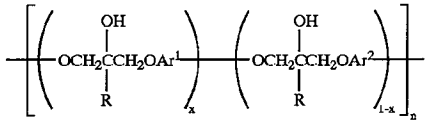


IIc



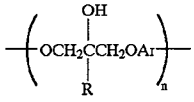
[0098] amide- and hydroxymethyl-functionalized polyethers having repeating units represented by Formula III:

III



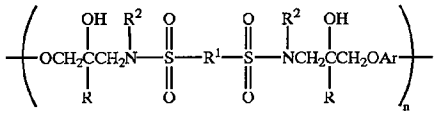
[0099] hydroxy-functional polyethers having repeating units represented by Formula IV:

IV

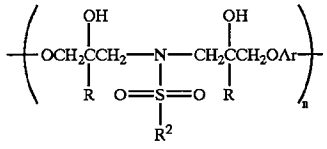


[0100] hydroxy-functional poly(ether sulfonamides) having repeating units represented by Formulae Va or Vb:

Va

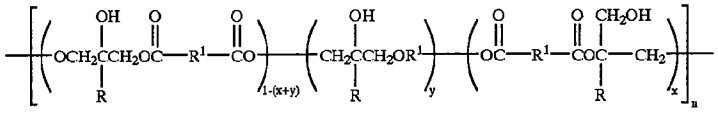


Vb

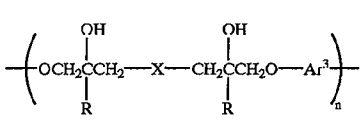


[0101] poly(hydroxy ester ethers) having repeating units represented by Formula VI:

VI



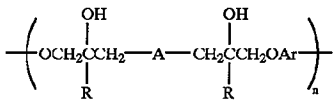
[0102] hydroxy-phenoxyether polymers having repeating units represented by Formula VII:



VII

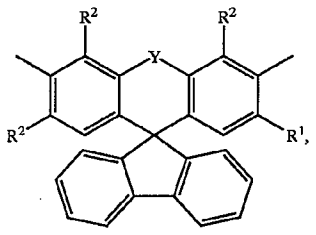
[0103] and

[0104] poly(hydroxyamino ethers) having repeating units represented by Formula VIII:



VIII

[0105] wherein each Ar individually represents a divalent aromatic moiety, substituted divalent aromatic moiety or heteroaromatic moiety, or a combination of different divalent aromatic moieties, substituted aromatic moieties or heteroaromatic moieties; R is individually hydrogen or a monovalent hydrocarbyl moiety; each Ar_1 is a divalent aromatic moiety or combination of divalent aromatic moieties bearing amide or hydroxymethyl groups; each Ar_2 is the same or different than Ar and is individually a divalent aromatic moiety, substituted aromatic moiety or heteroaromatic moiety or a combination of different divalent aromatic moieties, substituted aromatic moieties or heteroaromatic moieties; R_1 is individually a predominantly hydrocarbylene moiety, such as a divalent aromatic moiety, substituted divalent aromatic moiety, divalent heteroaromatic moiety, divalent alkylene moiety, divalent substituted alkylene moiety or divalent heteroalkylene moiety or a combination of such moieties; R_2 is individually a monovalent hydrocarbyl moiety; A is an amine moiety or a combination of different amine moieties; X is an amine, an arylenedioxy, an arylenedisulfonamido or an arylenedicarboxy moiety or combination of such moieties; and Ar_3 is a "cardo" moiety represented by any one of the Formulae:



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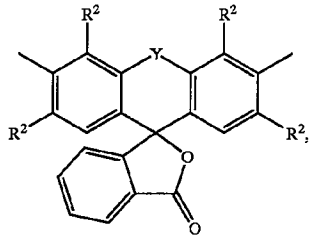

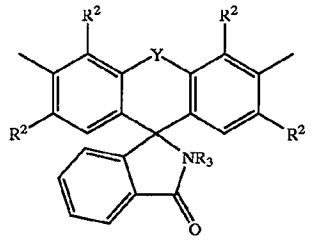

[0106] wherein Y is nil, a covalent bond, or a linking group, wherein suitable linking groups include, for example, an oxygen atom, a sulfur atom, a carbonyl atom, a sulfonyl group, or a methylene group or similar linkage; n is an integer from about 10 to about 1000; x is 0.01 to 1.0; and y is 0 to 0.5.

[0107] The term "predominantly hydrocarbylene" means a divalent radical that is predominantly hydrocarbon, but which optionally contains a small quantity of a heteroatomic moiety such as oxygen, sulfur, imino, sulfonyl, sulfoxyl, and the like.

[0108] The hydroxy-functional poly(amide ethers) represented by Formula I are preferably prepared by contacting an N,N'-bis(hydroxyphenylamido)alkane or arene with a diglycidyl ether as described in U.S. Pat. Nos. 5,089,588 and 5,143,998.

[0109] The poly(hydroxy amide ethers) represented by Formula II are prepared by contacting a bis(hydroxyphenylamido)alkane or arene, or a combination of 2 or more of these compounds, such as N,N'-bis(3-hydroxyphenyl) adipamide or N,N'-bis(3-hydroxyphenyl)glutaramide, with an epihalohydrin as described in U.S. Pat. No. 5,134,218.

[0110] The amide- and hydroxymethyl-functionalized polyethers represented by Formula III can be prepared, for example, by reacting the diglycidyl ethers, such as the diglycidyl ether of bisphenol A, with a dihydric phenol having pendant amido, N-substituted amido and/or hydroxyalkyl moieties, such as 2,2-bis(4-hydroxyphenyl)acetamide and 3,5-dihydroxybenzamide. These polyethers and their preparation are described in U.S. Pat. Nos. 5,115,075 and 5,218,075.

[0111] The hydroxy-functional polyethers represented by Formula IV can be prepared, for example, by allowing a diglycidyl ether or combination of diglycidyl ethers to react with a dihydric phenol or a combination of dihydric phenols using the process described in U.S. Pat. No. 5,164,472. Alternatively, the hydroxy-functional polyethers are

obtained by allowing a dihydric phenol or combination of dihydric phenols to react with an epihalohydrin by the process described by Reinking, Barnabeo and Hale in the Journal of Applied Polymer Science, Vol. 7, p. 2135 (1963).

[0112] The hydroxy-functional poly(ether sulfonamides) represented by Formula V are prepared, for example, by polymerizing an N,N'-dialkyl or N,N'-diaryldisulfonamide with a diglycidyl ether as described in U.S. Pat. No. 5,149,768.

[0113] The poly(hydroxy ester ethers) represented by Formula VI are prepared by reacting diglycidyl ethers of aliphatic or aromatic diacids, such as diglycidyl terephthalate, or diglycidyl ethers of dihydric phenols with, aliphatic or aromatic diacids such as adipic acid or isophthalic acid. These polyesters are described in U.S. Pat. No. 5,171,820.

[0114] The hydroxy-phenoxyether polymers represented by Formula VII are prepared, for example, by contacting at least one dinucleophilic monomer with at least one diglycidyl ether of a cardo bisphenol, such as 9,9-bis(4-hydroxyphenyl)fluorene, phenolphthalein, or phenolphthalimidine or a substituted cardo bisphenol, such as a substituted bis(hydroxyphenyl)fluorene, a substituted phenolphthalein or a substituted phenolphthalimidine under conditions sufficient to cause the nucleophilic moieties of the dinucleophilic monomer to react with epoxy moieties to form a polymer backbone containing pendant hydroxy moieties and ether, imino, amino, sulfonamido or ester linkages. These hydroxy-phenoxyether polymers are described in U.S. Pat. No. 5,184,373.

[0115] The poly(hydroxyamino ethers) ("PHAE" or polyetheramines) represented by Formula VIII are prepared by contacting one or more of the diglycidyl ethers of a dihydric phenol with an amine having two amine hydrogens under conditions sufficient to cause the amine moieties to react with epoxy moieties to form a polymer backbone having amine linkages, ether linkages and pendant hydroxyl moieties. These compounds are described in U.S. Pat. No. 5,275,853.

[0116] Phenoxy-type Thermoplastics of Formulae I-VIII may be acquired from Dow Chemical Company (Midland, Mich. U.S.A.).

[0117] The Phenoxy-type Thermoplastics commercially available from Phenoxy Associates, Inc. are also suitable for use. These hydroxy-phenoxyether polymers are the condensation reaction products of a dihydric polynuclear phenol, such as bisphenol A, and an epihalohydrin and have the repeating units represented by Formula IV wherein Ar is an isopropylidene diphenylene moiety. The process for preparing these is described in U.S. Pat. No. 3,305,528, incorporated herein by reference in its entirety.

[0118] Especially preferred hydroxy-phenoxyether polymers are the poly(hydroxyamino ethers) ("PHAE" or polyetheramines) represented by Formula VIII, sold as BLOX resins from The Dow Chemical Company, including, but not limited to BLOX 0005 and BLOX 0003.

[0119] Examples of preferred Copolyester Barrier Materials and a process for their preparation is described in U.S. Pat. No. 4,578,295 to Jabarin. They are generally prepared by heating a mixture of at least one reactant selected from isophthalic acid, terephthalic acid and their C_1 to C_4 alkyl esters with 1,3 bis(2-hydroxyethoxy)benzene and ethylene glycol. Optionally, the mixture may further comprise one or more ester-forming dihydroxy hydrocarbon and/or bis(4-β-hydroxyethoxyphenyl)sulfone. Especially preferred Copolyester Barrier Materials are available from Mitsui Petrochemical Ind. Ltd. (Japan) as B-010, B-030 and others of this family.

[0120] Examples of preferred polyamide barrier materials include MXD-6 from Mitsubishi Gas Chemical (Japan). Other preferred barrier materials are "Polyamide Blends" which are blends of polyamide and polyester containing preferably about 1-40% of polyester in polyamide, about 1-40% polyamide in polyester, or about 1-40% of the about 1-40% polyamide in polyester blend in polyamide. These blends more preferably include about 5-30% of the lesser component. The blends may incorporate a compatibilizer such as dianhydrides of tetracarboxylic acids, or other such compatibilizers such as are disclosed in European Patent Application No. 964,031. One preferred dianhydride is pyromellitic dianhydride (PMDA). It may be used to form blends or it may be incorporated into a single polymer to increase its ability to adhere to other layers of materials. The polyester used in Polyamide Blends is preferably PET, more preferably high IPA PET. Recycled PET may also be used such as to save materials costs or increase the recycled content of the article. If a Polyamide Blend is to be in contact with food, however, virgin materials are preferred. These materials are preferably made by adding the component present in smaller quantity to the polycondensation mixture of the polymer present in larger quantity. "Polyamide Blends" as used herein shall include all of the aforementioned types of blends, whether such blends were made by reacting or compounding of the materials.

[0121] Other preferred barrier materials include polyethylene naphthalate (PEN), PEN copolyester, and PET/PEN blends. PEN materials can be purchased from Shell Chemical Company.

[0122] C. Preparation of Polyesters

[0123] Polyesters and methods for their preparation (including the specific monomers employed in their formation, their proportions, polymerization temperatures, catalysts and other conditions) are well-known in the art and reference is made thereto for the purposes herein. For purposes of illustration and not limitation, reference is particularly made to pages 1-62 of Volume 12 of the Encyclopedia of Polymer Science and Engineering, 1988 revision, John Wiley & Sons.

[0124] Typically, polyesters are derived from the reaction of a di- or polycarboxylic acid with a di- or polyhydric alcohol. Suitable di- or polycarboxylic acids include polycarboxylic acids and the esters and anthydrides of such acids, and mixture thereof. Representative carboxylic acids include phthalic, isophthalic, adipic azelaic, terephthalic, oxalic, malonic, succinic, glutaric, sebacic, and the like. Dicarboxylic components are preferred. Terephthalic acid is most commonly employed and preferred in the preparation of polyester films. α,β-Unsaturated di- and polycarboxylic acids (including esters or anthydrides of such acids and mixtures thereof) can be used as partial replacement for the saturated carboxylic components. Representative α,β-unsaturated di- and polycarboxylic acids include maleic, fumaric, aconitic, itaconic, mesaconic, citraconic, monochloromaleic and the like.

[0125] Typical di- and polyhydric alcohols used to prepare the polyester are those alcohols having at least two hydroxy groups, although minor amounts of alcohol having more or less hydroxy groups may be used. Dihydroxy alcohols are preferred. Dihydroxy alcohols conventionally employed in the preparation of polyesters include diethylene glycol; dipropylene glycol; ethylene glycol; 1,2-propylene glycol; 1,4-butanediol; 1,4-pentanediol; 1,5-hexanediol, 1,4-cyclohexanedimethanol and the like with 1,2-propylene glycol being preferred. Mixtures of the alcohols can also be employed. The di- or polyhydric alcohol component of the polyester is usually stoichiometric or in slight excess with respect to the acid. The excess of the di- or polyhydric alcohol will seldom exceed about 20 to 25 mole percent and usually is between about 2 and about 10 mole percent.

[0126] The polyester is generally prepared by heating a mixture of the di- or polyhydric alcohol and the di- or polycarboxylic component in their proper molar ratios at elevated temperatures, usually between about 100° C. and 250° C. for extended periods of time, generally ranging from 5 to 15 hours. Polymerization inhibitors such as t-butylcatechol may advantageously be used.

[0127] PET, the preferred polyester, which is commonly made by condensation of terephthalic acid and ethylene glycol, may be purchased from Dow Chemical Company (Midland, Mich.), and Allied Signal Inc. (Baton Rouge, La.), among many others.

[0128] Preferably, the PET used is that in which isophthalic acid (IPA) is added during the manufacture of the PET to form a copolymer. The amount of IPA added is preferably 2-10% by weight, more preferably 3-8% by weight, most preferably 4-5% by weight. The most preferred range is based upon current FDA regulations which currently do not allow for PET materials having an IPA content of more than 5% to be in contact with food or drink. High-IPA PET (PET having more than about 2% IPA by weight) can be made as discussed above, or purchased from a number of different manufacturers, for instance PET with 4.8% IPA may be purchased from SKF (Italy) and 10% IPA PET may be purchased from INCA (Dow Europe).

[0129] Additionally, if a barrier material containing polyamide is chosen, it is preferred to use the Polyamide Blends.

[0130] D. Other Materials to Enhance Barrier Properties

[0131] The materials noted herein, including base materials, such as PET, barrier materials such as Phenoxy-type Thermoplastics, polyamides and Polyamide Blends, and other materials such as recycled PET may be used in combination with other materials which enhance or provide the barrier properties. Generally speaking, one cause for the diffusion of gases through a material is the existence of gaps or holes in the material at the molecular level through which the gas molecules can pass. The presence of intermolecular forces in a material, such as hydrogen bonding, allows for interchain cohesion in the matrix which closes these gaps and discourages diffusion of gases. One may also increase the gas-barrier ability of good barrier materials by adding an additional molecule or substance which takes advantage of such intermolecular forces and acts as a bridge between polymer chains in the matrix, thus helping to close the holes in the matrix and reduce gas diffusion.

[0132] Derivatives of the diol resorcinol (m-dihydroxybenzene), when reacted with other monomers in the manufacture of PHAE, PET, Copolyester Barrier Materials, and other barrier materials, will generally result in a material which has better barrier properties than the same material if it does not contain the resorcinol derivative. For example, resorcinol diglycidyl ether can be used in PHAE and hydroxyethyl ether resorcinol can be used in PET and other polyesters and Copolyester Barrier Materials.

[0133] One measure of the efficacy of a barrier is the effect that it has upon the shelf life of the material. The shelf life of a carbonated soft drink in a 32 oz PET non-barrier bottle is approximately 12-16 weeks. Shelf life is determined as the time at which less than 85% of the original amount of carbon dioxide is remaining in the bottle. Bottles coated with PHAE using the inject-over-inject method described below have been found to have a shelf life 2 to 3 times greater than that of PET alone. If, however, PHAE with resorcinol diglycidyl ether is used, the shelf life can be increased to 4 to 5 times that of PET alone.

[0134] Another way of enhancing the barrier properties of a material is to add a substance which "plugs" the holes in the polymer matrix and thus discourages gases from passing through the matrix. Alternatively, a substance may aid in creating a more tortuous path for gas molecules to take as they permeate a material. One such substance, referred to herein by the term "Nanoparticles" or "nanoparticular material" are tiny particles of materials which enhance the barrier properties of a material by creating a more tortuous path for migrating oxygen or carbon dioxide. One preferred type of nanoparticular material is a microparticular clay-based product available from Southern Clay Products.

[0135] Another way to provide or enhance barrier properties is to include an oxygen scavenger. Oxygen scavengers may be blended with a material by physical blending or mixing of the oxygen scavenger with pellets or flakes of a polymer or by compounding the oxygen scavenger with the polymer. Preferred oxygen scavengers include Amosorb 3000 from Amoco. Preferably, the oxygen scavenger is added at a level of 0.5 to 15% by weight, more preferably 1 to 10% by weight, including 5%, 7% and 9%. Other scavengers may be added at volumes which achieve the desired degree of effect, or at levels at or below which they have been approved for use in connection with packaging such as for foods.

[0136] E. Preparing Barrier-Coated Articles

[0137] Once a suitable barrier coating material is chosen, the coated preform must be made in a manner that promotes adhesion between the two materials. Generally, adherence between the barrier coating materials and PET increases as the surface temperature of the PET increases. Therefore, it is preferable to perform coating on heated preforms, although the preferred barrier materials will adhere to PET at room temperature. Although this discussion is in terms of barrier materials, the same principles noted herein apply to the coating or overmolding of RPET and PET and other such combinations of materials.

[0138] There are a number of methods of producing a coated PET preform in accordance with the preferred embodiments. Preferred methods include dip coating, spray coating, flame spraying fluidized bed dipping, and electrostatic powder spraying. Each of the above methods is described in copending U.S. application Ser. No. 09/147,

971, which was filed on Oct. 19, 1998, entitled BARRIER-COATED POLYESTER, which is hereby incorporated by reference in its entirety.

[0139] An especially preferred method of producing a coated PET preform is referred to herein generally as overmolding, and sometimes as inject-over-inject ("IOI"). The name refers to a procedure which uses injection molding to inject one or more layers of barrier material over an existing preform, which preferably was itself made by injection molding. The terms "overinjecting" and "overmolding" are used herein to describe the coating process whereby a layer of material, preferably comprising barrier material, is injected over an existing preform. In an especially preferred embodiment, the overinjecting process is performed while the underlying preform has not yet fully cooled. Overinjecting may be used to place one or more additional layers of materials such as those comprising barrier material, recycled PET, or other materials over a coated or uncoated preform. The IOI process is described in the application noted above as well as copending U.S. application Ser. No. 09/296,695, which was filed on Apr. 21, 1999 entitled APPARATUS AND METHOD FOR MAKING BARRIER-COATED POLYESTER, which is hereby incorporated by reference in its entirety.

[0140] 1. Prefered Overmolding (Inject-over-Inject) Processes

[0141] The overmolding is preferably carried out by using an injection molding process using equipment similar to that used to form the uncoated preform itself. A preferred mold for overmolding, with an uncoated preform in place is shown in **FIG. 7**. The mold comprises two halves, a cavity half **92** and a mandrel half **94**, and is shown in **FIG. 7** in the closed position prior to overinjecting. The cavity half **92** comprises a cavity in which the uncoated preform is placed. The support ring **38** of the preform rests on a ledge **96** and is held in place by the mandrel half **94**, which exerts pressure on the support ring **38**, thus sealing the neck portion off from the body portion of the preform. The cavity half **92** has a plurality of tubes or channels **104** therein which carry a fluid. Preferably the fluid in the channels circulates in a path in which the fluid passes into an input in the cavity half **92**, through the channels **104**, out of the cavity half **92** through an output, through a chiller or other cooling device, and then back into the input. The circulating fluid serves to cool the mold, which in turn cools the plastic melt which is injected into the mold to form the coated preform.

[0142] The mandrel half **94** of the mold comprises a mandrel **98**. The mandrel **98**, sometimes called a core, protrudes from the mandrel half **94** of the mold and occupies the central cavity of the preform. In addition to helping to center the preform in the mold, the mandrel **98** cools the interior of the preform. The cooling is done by fluid circulating through channels **106** in the mandrel half **94** of the mold, most importantly through the length of the mandrel **98** itself. The channels **106** of the mandrel half **94** work in a manner similar to the channels **104** in the cavity half **92**, in that they create the portion of the path through which the cooling fluid travels which lies in the interior of the mold half.

[0143] As the preform sits in the mold cavity, the body portion of the preform is centered within the cavity and is completely surrounded by a void space **100**. The preform, thus positioned, acts as an interior die mandrel in the subsequent injection procedure. The melt of the overmolding material, preferably comprising a barrier material, is then introduced into the mold cavity from the injector via gate **102** and flows around the preform, preferably surrounding at least the body portion **34** of the preform. Following overinjection, the overmolded layer will take the approximate size and shape of the void space **100**.

[0144] To carry out the overmolding procedure, one preferably heats the initial preform which is to be coated preferably to a temperature above its Tg. In the case of PET, that temperature is preferably about 60 to 175° C., more preferably about 80-110° C. If a temperature at or above the minimum temperature of crystallization for PET is used, which is about 120° C., care should be taken when cooling the PET in the preform. The cooling should be sufficient to minimize crystallization of the PET in the preform so that the PET is in the preferred semi-crystalline state. Advantageously, the neck portion of the preform is not in contact with the melt of overriding material, and thus retains its crystalline structure. Alternatively, the initial preform used may be one which has been very recently injection molded and not fully cooled, as to be at an elevated temperature as is preferred for the overmolding process.

[0145] The coating material is heated to form a melt of a viscosity compatible with use in an injection molding apparatus. The temperature for this, the inject temperature, will differ among materials, as melting ranges in polymers and viscosities of melts may vary due to the history, chemical character, molecular weight, degree of branching and other characteristics of a material. For the preferred barrier materials disclosed above, the inject temperature is preferably in the range of about 160-325° C., more preferably 200 to 275° C. For example, for the Copolyester Barrier Material B-010, the preferred temperature is around 210° C., whereas for the PHAE XU-19040.00L, BLOX 0005 or BLOX 0003 the preferred temperature is in the range of 160-260° C., and is more preferably about 175-240° C. Most preferably, the PHAE inject temperature is about 175-200° C. If recycled PET is used, the inject temperature is preferably 250-320° C. The coating material is then injected into the mold in a volume sufficient to fill the void space **100**. If the coating material comprises barrier material, the coating layer is a barrier layer.

[0146] The coated preform is preferably cooled at least to the point where it can be displaced from the mold or handled without being damaged, and removed from the mold where further cooling may take place. If PET is used, and the preform has been heated to a temperature near or above the temperature of crystallization for PET, the cooling should be fairly rapid and sufficient to ensure that the PET is primarily in the semi-crystalline state when the preform is fully cooled. As a result of this process, a strong and effective bonding takes place between the initial preform and the subsequently applied coating material.

[0147] Overmolding can be also used to create coated preforms with three or more layers. In **FIG. 14**, there is shown a three-layer embodiment of a preform **132** in accordance with one preferred embodiment. The preform shown therein has two coating layers, a middle layer **134** and an outer layer **134**. The relative thickness of the layers shown in **FIG. 16** may be varied to suit a particular combination of

layer materials or to allow for the making of different sized bottles. As will be understood by one skilled in the art, a procedure analogous to that disclosed above would be followed, except that the initial preform would be one which had already been coated, as by one of the methods for making coated preforms described herein, including overmolding.

[0148] a. A Preferred Method and Apparatus for Overmolding

[0149] A preferred apparatus for performing the overmolding process is based upon the use of a 330-330-200 machine by Engel (Austria). The preferred mold portion the machine is shown schematically in FIGS. **8-13** and comprises a movable half **142** and a stationary half **144**. Both halves are preferably made from hard metal. The stationary half **144** comprises at least two mold sections **146, 148**, wherein each mold section comprises N (N>0) identical mold cavities **114, 120**, an input and output for cooling fluid, channels allowing for circulation of cooling fluid within the mold section, injection apparatus, and hot runners channeling the molten material from the injection apparatus to the gate of each mold cavity. Because each mold section forms a distinct preform layer, and each preform layer is preferably made of a different material, each mold section is separately controlled to accommodate the potentially different conditions required for each material and layer. The injector associated with a particular mold section injects a molten material, at a temperature suitable for that particular material, through that mold section's hot runners and gates and into the mold cavities. The mold section's own input and output for cooling fluid allow for changing the temperature of the mold section to accommodate the characteristics of the particular material injected into a mold section. Consequently, each mold section may have a different injection temperature, mold temperature, pressure, injection volume, cooling fluid temperature, etc. to accommodate the material and operational requirements of a particular preform layer.

[0150] The movable half **142** of the mold comprises a turntable **130** and a plurality of cores or mandrels **98**. The alignment pins guide the movable half **142** to slidably move in a preferably horizontal direction towards or away from the stationary half **144**. The turntable **130** may rotate in either a clockwise or counterclockwise direction, and is mounted onto the movable half **142**. The plurality of mandrels **98** are affixed onto the turntable **130**. These mandrels **98** serve as the mold form for the interior of the preform, as well as serving as a carrier and cooling device for the preform during the molding operation. The cooling system in the mandrels is separate from the cooling system in the mold sections.

[0151] The mold temperature or cooling for the mold is controlled by circulating fluid. There is separate cooling fluid circulation for the movable half **142** and for the overmolding section **148** of the stationary half **144**. Additionally, the initial preform mold section **146** of the stationary half **144** comprises two separate cooling fluid circulation systems; one for the non-crystalline regions and one for the crystalline regions. Each cooling fluid circulation set up works in a similar manner. The fluid enters the mold, flows through a network of channels or tubes inside as discussed above for **FIG. 7**, and then exits through an output. From the output, the fluid travels through a pump, which keeps the fluid flowing, and a chilling system to keep the fluid within the desired temperature range, before going back into the mold.

[0152] In a preferred embodiment, the mandrels and cavities are constructed of a high heat transfer material, such a beryllium, which is coated with a hard metal, such as tin or chrome. The hard coating keeps the beryllium from direct contact with the preform, as well as acting as a release for ejection and providing a hard surface for long life. The high heat transfer material allows for more efficient cooling, and thus assists in achieving lower cycle times. The high heat transfer material may be disposed over the entire area of each mandrel and/or cavity, or it may be only on portions thereof. Preferably at least the tips of the mandrels comprise high heat transfer material. Another, even more preferred high heat transfer material is AMPCOLOY, which is commercially available from Uudenholm, Inc.

[0153] The number of mandrels is equal to the total number of cavities, and the arrangement of the mandrels **98** on the movable half **142** mirrors the arrangement of the cavities **114, 120** on the stationary half **144**. To close the mold, the movable half **142** moves towards the stationary half **144**, mating the mandrels **98** with the cavities **114, 120**. To open the mold, the movable half **142** moves away from the stationary half **144** such that the mandrels **98** are well clear of the block on the stationary half **144**. After the mandrels are fully withdrawn **98** from the mold sections **146, 148**, the turntable **130** of the movable half **142** rotates the mandrels **98** into alignment with a different mold section. Thus, the movable half rotates 360°/(number of mold sections in the stationary half) degrees after each withdrawal of the mandrels from the stationary half. When the machine is in operation, during the withdrawal and rotation steps, there will be preforms present on some or all of the mandrels.

[0154] The size of the cavities in a given mold section **146, 148** will be identical; however the size of the cavities will differ among the mold sections. The cavities in which the uncoated preforms are first molded, the preform molding cavities **114**, are smallest in size. The size of the cavities **120** in the mold section **148** in which the first coating step is performed are larger than the preform molding cavities **114**, in order to accommodate the uncoated preform and still provide space for the coating material to be injected to form the overmolded coating. The cavities in each subsequent mold section wherein additional overmolding steps are performed will be increasingly larger in size to accommodate the preform as it gets larger with each coating step.

[0155] After a set of preforms has been molded and overmolded to completion, a series of ejectors eject the finished preforms off of the mandrels **98**. The ejectors for the mandrels operate independently, or at least there is a single ejector for a set of mandrels equal in number and configuration to a single mold section, so that only the completed preforms are ejected. Uncoated or incompletely-coated preforms remain on the mandrels so that they may continue in the cycle to the next mold section. The ejection may cause the preforms to completely separate from the mandrels and fall into a bin or onto a conveyor. Alternatively, the preforms may remain on the mandrels after ejection, after which a robotic arm or other such apparatus grasps a preform or group of preforms for removal to a bin, conveyor, or other desired location.

[0156] **FIGS. 8 and 9** illustrate a schematic for an embodiment of the apparatus described above. **FIG. 9** is the stationary half **144** of the mold. In this embodiment, the block **124** has two mold sections, one section **146** comprising a set of three preform molding cavities **114** and the other section **148** comprising a set of three preform coating cavities **120**. Each of the preform coating cavities **120** is preferably like that shown in **FIG. 7**, discussed above. Each of the preform molding cavities **114** is preferably similar to that shown in **FIG. 15**, in that the material is injected into a space defined by the mandrel **98** (albeit without a preform already thereon) and the wall of the mold which is cooled by fluid circulating through channels inside the mold block. Consequently, one full production cycle of this apparatus will yield three two-layer preforms. If more than three preforms per cycle is desired, the stationary half can be reconfigured to accommodate more cavities in each of the mold sections. An example of this is seen in **FIG. 11**, wherein there is shown a stationary half of a mold comprising two mold sections, one **146** comprising forty-eight preform molding cavities **114** and the other **148** comprising forty-eight preform coating cavities **120**. If a three or more layer preform is desired, the stationary half **144** can be reconfigured to accommodate additional mold sections, one for each preform layer

[0157] **FIG. 8** illustrates the movable half **142** of the mold. The movable half comprises six identical mandrels **98** mounted on the turntable **130**. Each mandrel **98** corresponds to a cavity on the stationary half **144** of the mold. The movable half also comprises alignment pegs **110**, which correspond to the receptacles **112** on the stationary half **144**. When the movable half **142** of the mold moves to close the mold, the alignment pegs **110** are mated with their corresponding receptacles **112** such that the molding cavities **114** and the coating cavities **120** align with the mandrels **98**. After alignment and closure, half of the mandrels **98** are centered within preform molding cavities **114** and the other half of the mandrels **98** are centered within preform coating cavities **120**.

[0158] The configuration of the cavities, mandrels, and alignment pegs and receptacles must all have sufficient symmetry such that after the mold is separated and rotated the proper number of degrees, all of the mandrels line up with cavities and all alignment pegs line up with receptacles. Moreover, each mandrel must be in a cavity in a different mold section than it was in prior to rotation in order to achieve the orderly process of molding and overmolding in an identical fashion for each preform made in the machine.

[0159] Two views of the two mold halves together are shown in **FIGS. 12 and 13**. In **FIG. 12**, the movable half **142** is moving towards the stationary half **144**, as indicated by the arrow. Two mandrels **98**, mounted on the turntable **130**, are beginning to enter cavities, one enters a molding cavity **114** and the other is entering a coating cavity **120** mounted in the block **124**. In **FIG. 13**, the mandrels **98** are fully withdrawn from the cavities on the stationary side. The preform molding cavity **114** has two cooling circulation systems which are separate from the cooling circulation for the preform coating cavity **120**, which comprises the other mold section **148**. The two mandrels **98** are cooled by a single system that links all the mandrels together. The arrow in **FIG. 13** shows the rotation of the turntable **130**. The turntable **130** could also rotate clockwise. Not shown are coated and uncoated preforms which would be on the mandrels if the machine were in operation. The alignment pegs and receptacles have also been left out for the sake of clarity.

[0160] The operation of the overmolding apparatus will be discussed in terms of the preferred two mold section apparatus for making a two-layer preform. The mold is closed by moving the movable half **142** towards the stationary half **144** until they are in contact. A first injection apparatus injects a melt of first material into the first mold section **146**, through the hot runners and into the preform molding cavities **114** via their respective gates to form the uncoated preforms each of which become the inner layer of a coated preform. The first material fills the void between the preform molding cavities **114** and the mandrels **98**. Simultaneously, a second injection apparatus injects a melt of second material into the second mold section **148** of the stationary half **144**, through the hot runners and into each preform coating cavity **120** via their respective gates, such that the second material fills the void (**100** in **FIG. 9**) between the wall of the coating cavity **120** and the uncoated preform mounted on the mandrel **98** therein.

[0161] During this entire process, cooling fluid is circulating through the four separate areas, corresponding to the non-crystalline regions of mold section **146** of the preform molding cavities **114**, the crystalline regions of mold section **146** of the preform molding cavities **114**, mold section **148** of the preform coating cavities **120**, and the movable half **142** of the mold, respectively. Thus, the melts and preforms are being cooled in the center by the circulation in the movable half that goes through the interior of the mandrels, as well as on the outside by the circulation in each of the cavities.

[0162] The movable half **142** then slides back to separate the two mold halves and open the mold until all of the mandrels **98** having preforms thereon are completely withdrawn from the preform molding cavities **114** and preform coating cavities **120**. The ejectors eject the coated, finished preforms off of the mandrels **98** which were just removed from the preform coating cavities. As discussed above, the ejection may cause the preforms to completely separate from the mandrels and fall into a bin or onto a conveyor, or if the preforms remain on the mandrels after ejection, a robotic arm or other apparatus may grasp a preform or group of preforms for removal to a bin, conveyor, or other desired location. The turntable **130** then rotates 180° so that each mandrel **98** having an uncoated preform thereon is positioned over a preform coating cavity **120**, and each mandrel from which a coated preform was just ejected is positioned over a preform molding cavity **114**. Rotation of the turntable **130** may occur as quickly as 0.5-0.9 seconds. Using the alignment pegs **110**, the mold halves again align and close, and the first injector injects the first material into the preform molding cavity **114** while the second injector injects the barrier material into the preform coating cavity **120**.

[0163] A production cycle of closing the mold, injecting the melts, opening the mold, ejecting finished barrier preforms, rotating the turntable, and closing the mold is repeated, so that preforms are continuously being molded and overmolded.

[0164] When the apparatus first begins running, during the initial cycle, no preforms are yet in the preform coating

cavities **120**. Therefore, the operator should either prevent the second injector from injecting the second material into the second mold section during the first injection, or allow the second material to be injected and eject and then discard the resulting single layer preform comprised solely of the second material. After this start-up step, the operator may either manually control the operations or program the desired parameters such that the process is automatically controlled.

[0165] Two layer preforms may be made using the first preferred overmolding apparatus described above. In one preferred embodiment, the two layer preform comprises an inner layer comprising polyester and an outer layer comprising barrier material. In especially preferred embodiments, the inner layer comprises virgin PET. The description hereunder is directed toward the especially preferred embodiments of two layer preforms comprising an inner layer of virgin PET, in which the neck portion is generally crystalline and the body portion is generally non-crystalline. The description is directed toward describing the formation of a single set of coated preforms **60** of the type seen in **FIG. 4**, that is, following a set of preforms through the process of molding, overmolding and ejection, rather than describing the operation of the apparatus as a whole. The process described is directed toward preforms having a total thickness in the wall portion **66** of about 3 mm, comprising about 2 mm of virgin PET and about 1 mm of barrier material. The thickness of the two layers will vary in other portions of the preform **60**, as shown in **FIG. 4**.

[0166] It will be apparent to one skilled in the art that some of the parameters detailed below will differ if other embodiments of preforms are used. For example, the amount of time which the mold stays closed will vary depending upon the wall thickness of the preforms. However, given the disclosure below for this preferred embodiment and the remainder of the disclosure herein, one skilled in the art would be able to determine appropriate parameters for other preform embodiments.

[0167] The apparatus described above is set up so that the injector supplying the mold section **146** containing the preform molding cavities **114** is fed with virgin PET and that the injector supplying the mold section **148** containing the preform coating cavities **120** is fed with a barrier material.

[0168] The movable half **142** of the mold is moved so that the mold is closed. A melt of virgin PET is injected through the back of the block **124** and into each preform molding cavity **114** to form an uncoated preform **30** which becomes the inner layer of the coated preform. The injection temperature of the PET melt is preferably 250 to 320° C., more preferably 255 to 280° C. The mold is kept closed for preferably 3 to 10 seconds, more preferably 4 to 6 seconds while the PET melt stream is injected and then cooled by the coolant circulating in the mold.

[0169] In the first step, the PET substrate is injection molded by injecting molten PET into the cavities formed by the molds and cores in the mold stack. When the cavity is filled, the resin in the body portion will come into contact with cooling surfaces and the resin in the neck finish will come into contact with the heated thread mold. As the PET in the neck finish cools, it will begin to crystallize as a result of this contact with the relatively hot mold. Once in contact, the crystallization will start and continue at a rate determined by time and temperature. When the neck finish portion of the molds are kept above the minimum temperature of crystallization of the PET used, crystallization will begin on contact. Higher temperatures will increase the rate of crystallization and decrease the time required to reach the optimum level of crystallization while maintaining post mold dimensional stability of the neck finish of the preform. At the same time the resin in the neck finish portion is cooling into a crystallized state, the resin in the body portion or lower body portion of the preform will be in contact with the chilled portions of the mold and thus cooled into an amorphous or semi-crystalline state.

[0170] The movable half **142** of the mold is then moved so that the two halves of the mold are separated at or past the point where the newly molded preforms, which remain on the mandrels **98**, are clear of the stationary side **144** of the mold. When the mandrels **98** are clear of the stationary side **144** of the mold, the turntable **130** then rotates 180° so that each mandrel **98** having a molded preform thereon is positioned over a preform coating cavity **120**. Thus positioned, each of the other mandrels **98** which do not have molded preforms thereon, are each positioned over a preform molding cavity **114**. The mold is again closed. Preferably the time between removal from the preform molding cavity **114** to insertion into the preform coating cavity **120** is 1 to 10 seconds, and more preferably 1 to 3 seconds.

[0171] When the molded preforms are first placed into preform coating cavities **120**, the exterior surfaces of the body portions of the preforms are not in contact with a mold surface. Thus, the exterior skin of the body portion is still softened and hot as described above because the contact cooling is only from the mandrel inside. The high temperature of the exterior surface of the uncoated preform (which forms the inner layer of the coated preform) aids in promoting adhesion between the PET and barrier layers in the finished barrier coated preform. It is postulated that the surfaces of the materials are more reactive when hot, and thus chemical interactions between the barrier material and the virgin PET will be enhanced by the high temperatures. Barrier material will coat and adhere to a preform with a cold surface, and thus the operation may be performed using a cold initial uncoated preform, but the adhesion is markedly better when the overmolding process is done at an elevated temperature, as occurs immediately following the molding of the uncoated preform. As discussed earlier, the neck portion of the preform has desirably crystallized from the separated, thermally isolated cooling fluid systems in the preform molding cavity. Since the coating operation does not place barrier material on the neck portion, its crystalline structure is substantially undisturbed.

[0172] A second injection operation then follows in which a melt of a barrier material is injected into each preform coating cavity **120** to coat the preforms. The temperature of the melt of barrier material is preferably 160 to 325° C. The exact temperature range for any individual barrier material is dependent upon the specific characteristics of that barrier material, but it is well within the abilities of one skilled in the art to determine a suitable range by routine experimentation given the disclosure herein. For example, if BLOX 0005 or BLOX 0003 is used, the temperature of the melt (inject temperature) is preferably 160 to 260° C., more preferably 200 to 240° C., and most preferably 175 to 200° C. If the Copolyester Barrier Material B-010 is used, the

injection temperature is preferably 160 to 260° C., more preferably 190 to 250° C. During the same time that this set of preforms are being overmolded with barrier material in the preform coating cavities **120**, another set of uncoated preforms is being molded in the preform molding cavities **114** as described above.

[0173] The two halves of the mold are again separated preferably 3 to 10 seconds, more preferably 4 to 6 seconds following the initiation of the injection step. The preforms which have just been barrier coated in the preform coating cavities **120**, are ejected from the mandrels **98**. The uncoated preforms which were just molded in preform molding cavities **114** remain on their mandrels **98**. The turntable **130** is then rotated 180° so that each mandrel having an uncoated preform thereon is positioned over a coating cavity **120** and each mandrel **98** from which a coated preform was just removed is positioned over a molding cavity **114**.

[0174] The cycle of closing the mold, injecting the materials, opening the mold, ejecting finished barrier preforms, rotating the turntable, and closing the mold is repeated, so that preforms are continuously being molded and overmolded. Those of skill in the art will appreciate that dry cycle time of the apparatus may increase the overall production cycle time for molding a complete preform.

[0175] The process using modified molds and chilled cores will produce a unique combination of amorphous/crystalline properties. As the core is chilled and the thread mold is heated, the thermal transfer properties of the PET act as a barrier to heat exchange. The heated thread molds crystallize the PET at the surface of the thread finish, and the PET material transitions into an amorphous form near the core as the temperature of the PET reduces closer to the core. This variation of the material from the inner (core) portion to the outer (thread) portion is also referred to herein as the crystallinity gradient.

[0176] The core temperature and the rate of crystallization of the resin play a part in determining the depth of crystallized resin. In addition, the amorphous inner surface of the neck finish stabilizes the post mold dimensions allowing closer molding tolerances than other crystallizing processes. On the other side, the crystallized outer surface supports the amorphous structure during high temperature filling of the container. Physical properties are also enhanced (e.g. brittleness, impact etc.) as a result of this unique crystalline/amorphous structure.

[0177] The optimum temperature for crystallization may vary depending upon factors including resin grade, resin crystallization temperature, intrinsic viscosity, wall thickness, exposure time, mold temperature. Preferred resins include PET homopolymer and copolymers (including but not limited to high-IPA PET, Copolyester Barrier Materials, and copolymers of PET and polyamides) and PEN. Such resins preferably have low intrinsic viscosities and moderate melt temperatures, preferably IVs of about 74 is 86, and melt temperatures of about 220-300° C. The preferred mold temperature range for PET is from about 240-280° C., with the maximum crystallization rate occurring at about 180° C., depending upon the above factors, the preferred exposure time range is from about 20 to 60 seconds overall, which includes both injection steps in inject-over-inject embodiments, and the preferred injection cavity pressure range is about 5000 to 22000 PSI. Thicker finish wall thickness will require more time to achieve a particular degree of crystallinity as compared to that needed for a thinner wall thickness. Increases in exposure time (time in mold) will increase the depth of crystallinity and the overall percentage of crystallinity in the area, and changes in the mold temperature in the region for which crystallinity is desired will affect the crystallinity rate and dimensional stability.

[0178] One of the many advantages of using the process disclosed herein is that the cycle times for the process are similar to those for the standard process to produce uncoated preforms; that is the molding and coating of preforms by this process is done in a period of time similar to that required to make uncoated PET preforms of similar size by standard methods currently used in preform production. Therefore, one can make barrier coated PET preforms instead of uncoated PET preforms without a significant change in production output and capacity.

[0179] If a PET melt cools slowly, the PET will take on a crystalline form. Because crystalline polymers do not blow mold as well as amorphous polymers, a preform comprised of a body portion of crystalline PET would not be expected to perform as well in forming containers as one having a body portion formed of PET having a generally non-crystalline form. If, however, the body portion is cooled at a rate faster than the crystal formation rate, as is described herein, crystallization of the PET will be minimized and the PET will take on an amorphous or semi-crystalline form. Thus, sufficient cooling of the PET in the body portion of the preform is crucial to forming preforms which will perform as needed when processed.

[0180] The rate at which a layer of PET cools in a mold such as described herein is proportional to the thickness of the layer of PET, as well as the temperature of the cooling surfaces with which it is in contact. If the mold temperature factor is held constant, a thick layer of PET cools more slowly than a thin layer. This is because it takes a longer period of time for heat to transfer from the inner portion of a thick PET layer to the outer surface of the PET which is in contact with the cooling surfaces of the mold than it would for a thinner layer of PET because of the greater distance the heat must travel in the thicker layer. Thus, a preform having a thicker layer of PET needs to be in contact with the cooling surfaces of the mold for a longer time than does a preform having a thinner layer of PET. In other words, with all things being equal, it takes longer to mold a preform having a thick wall of PET than it takes to mold a preform having a thin wall of PET.

[0181] The uncoated preforms, including those made by the first injection in the above-described apparatus, are preferably thinner than a conventional PET preform for a given container size. This is because in making the barrier coated preforms, a quantity of the PET which would be in a conventional PET preform can be displaced by a similar quantity of one of the preferred barrier materials. This can be done because the preferred barrier materials have physical properties similar to PET, as described above. Thus, when the barrier materials displace an approximately equal quantity of PET in the walls of a preform or container, there will not be a significant difference in the physical performance of the container. Because the preferred uncoated preforms which form the inner layer of the barrier coated preforms are thin-walled, they can be removed from the mold sooner than

their thicker-walled conventional counterparts. For example, the uncoated preform can be removed from the mold preferably after about 4-6 seconds without the body portion crystallizing, as compared to about 12-24 seconds for a conventional PET preform having a total wall thickness of about 3 mm. All in all, the time to make a barrier coated preform is equal to or slightly greater (up to about 30%) than the time required to make a monolayer PET preform of this same total thickness.

[0182] Additionally, because the preferred barrier materials are amorphous, they will not require the same type of treatment as the PET. Thus, the cycle time for a molding-overmolding process as described above is generally dictated by the cooling time required by the PET. In the above-described method, barrier coated preforms can be made in about the same time it takes to produce an uncoated conventional preform.

[0183] The advantage gained by a thinner preform can be taken a step farther if a preform made in the process is of the type in **FIG. 4**. In this embodiment of a coated preform, the PET wall thickness at 70 in the center of the area of the end cap **42** is reduced to preferably about ⅓ of the total wall thickness. Moving from the center of the end cap out to the end of the radius of the end cap, the thickness gradually increases to preferably about ⅔ of the total wall thickness, as at reference number **68** in the wall portion **66**. The wall thickness may remain constant or it may, as depicted in **FIG. 4**, transition to a lower thickness prior to the support ring **38**. The thickness of the various portions of the preform may be varied, but in all cases, the PET and barrier layer wall thicknesses must remain above critical melt flow thickness for any given preform design.

[0184] Using preforms **60** of the design in **FIG. 4** allows for even faster cycle times than that used to produce preforms **50** of the type in **FIG. 3**. As mentioned above, one of the biggest barriers to short cycle time is the length of time that the PET needs to be cooled in the mold following injection. If the body portion of a preform comprising PET has not sufficiently cooled before it is ejected from the mandrel, it will become substantially crystalline and potentially cause difficulties during blow molding. Furthermore, if the PET layer has not cooled enough before the overmolding process takes place, the force of the barrier material entering the mold will wash away some of the PET near the gate area. The preform design in **FIG. 4** takes care of both problems by making the PET layer thinnest in the center of the end cap region **42**, which is where the gate is in the mold. The thin gate section allows the gate area to cool more rapidly, so that the uncoated PET layer may be removed from the mold in a relatively short period of time while still avoiding crystallization of the gate area and washing of the PET during the second injection or overmolding phase.

[0185] The physical characteristics of the preferred barrier materials help to make this type of preform design workable. Because of the similarity in physical properties, containers having wall portions which are primarily barrier material can be made without sacrificing the performance of the container. If the barrier material used were not similar to PET, a container having a variable wall composition as in **FIG. 4** would likely have weak spots or other defects that could affect container performance.

[0186] b. Improving Mold Performance

[0187] As discussed above, the mold halves have an extensive cooling system comprising circulating coolant throughout the mold in order to conduct heat away and thus enhance the mold's heat absorption properties. With next reference to **FIG. 15**, which is a cross-section of a mold mandrel **298** and cavity **300** having features in accordance with preferred embodiments, the mold cooling system can be optimized for the mold cavities by arranging cooling tubes **302** in a spiral around the mold cavity **300** and just below the surface **304**. The rapid cooling enabled by such a cooling system helps avoid crystallization of the PET layer in the body portion of the preform during cooling. Also, the rapid cooling decreases the production cycle time by allowing injected preforms to be removed from the mold cavities quickly so that the mold cavity **300** may be promptly reused.

[0188] As discussed above, the gate area **306** of the mold cavity **300** is especially pivotal in determining cycle time. The void space near the gate **308**, which will make up the molded preform's base end **304**, receives the last portion of the melt stream to be injected into the mold cavity **300**. Thus, this portion is the last to begin cooling. If the PET layer has not sufficiently cooled before the overmolding process takes place, the force of the barrier material melt entering the mold may wash away some of the PET near the gate area **308**. To speed cooling in the gate area of the mold cavity in order to decrease cycle time, inserts **310** of an especially high heat transfer material, including, but not limited to, a beryllium-free copper alloy (sold under the trade name AMPCOLOY), can be disposed in the mold in the gate area **308**. These AMPCOLOY inserts **310** will withdraw heat at an especially fast rate. To enhance and protect the AMPCOLOY inserts **310**, a thin layer of titanium nitride or hard chrome may be deposited on the surface **312** of the AMPCOLOY to form a hard surface. Such a deposited surface would be preferably between only 0.001 to 0.01 inches thick and would most preferably be about 0.002 inches thick.

[0189] As discussed above, the mandrel **298** is especially important in the cooling process because it directly cools the inner PET layer. To enhance the cooling effect of the mandrel **298** on the inner surface of the preform and especially to enhance the cooling effect of the mandrel **298** at the preform's gate area/base end **314**, the mandrel **298** is preferably substantially hollow, having a relatively thin uniform wall **320**, as shown in **FIG. 26**. Preferably, this uniform thickness is between 0.1 inch and 0.3 inches and is most preferably about 0.2 inches. It is particularly important that the wall **320** at the base end **322** of the mandrel **298** is no thicker than the rest of the mandrel wall **314** because the thin wall aids in rapidly communicating heat away from the molten gate area **314** of the injected preform.

[0190] To further enhance the mandrel's cooling capability, cooling water may be supplied in a bubbler arrangement **330**. A core tube **332** is disposed centrally in the mandrel **298** and delivers chilled coolant C to the base end **322** thereof. Since the base end **322** is the first point of the mandrel **298** contacted by this coolant C, the coolant is coldest and most effective at this location. Thus, the gate area **314** of the injected preform is cooled at a faster rate than the rest of the preform. Coolant injected into the mandrel at the base end **322** proceeds along the length of the mandrel **298** and exits

through an output line **334**. A plurality of ribs **336** are arranged in a spiral pattern around the core tube **332** to direct coolant C along the mandrel wall.

[0191] In other embodiments where greater crystallinity and less crystalline gradient is desired, molds which are modified as described above are paired with cores modified as follows. In the modified cores, the fluid circulation in the cores is modified such that, for the portions to form the crystalline preform parts, the fluid circulation is independent and at a relatively higher temperature, or the flow of chilled fluid is restricted or altered in these regions such that the temperature of the surface of the core in the portion which forms the crystalline portion of the preform is higher than that in the body regions. Alternatively, the relevant portions of the core may be heated other means as described above. Use of cores having these characteristics allows for a greater degree of crystallization towards and/or at the inner surface of the preform in the neck, neck finish and/or neck cylinder area and a lesser crystalline gradient between the inner surface and the outer surface in these areas.

[0192] **FIG. 18** is a schematic representation of one such modified core **298'**, configured to achieve greater crystallinity of the neck portion of an injected preform. The mold of **FIG. 18** is similar in construction to the mold described above with reference to **FIG. 15**. Accordingly, like reference characters will be used to describe like components, except that a (') will be used to denote modified components.

[0193] The core **298'** of **FIG. 18** includes a double wall portion **408** generally adjacent to the neck finish portion **402** of the mold. An inner wall **410** substantially inhibits circulating fluid C from coming into contact with the outer wall **412** of the core **298'** in the region proximate the neck finish portion **402** of the mold. In addition, an insulating space **414** is defined between the inner wall and outer wall **412**. Accordingly, the insulating space **414** reduces the cooling effect of the circulating fluid C on the neck portion of a preform within the mold cavity **300** thereby increasing the crystallinity of the resulting preform, and reducing the crystallinity gradient between the outer surface and the inner surface of the resulting preform.

[0194] The inner wall **410** of the modified core **298** may optionally include one or more openings **416**. These openings **416** permit circulating fluid C to enter the insulating space **414**. Preferably, the size of the openings **416** are configured such that a limited amount of circulating fluid C enters the insulating space **414**. Such a construction provides a greater cooling effect on the neck portion of the resulting preform than when no fluid is permitted within the insulating space **414**, but less cooling than unrestricted contact of the circulating fluid C with the outer wall **412** of the core **298**. Advantageously, adjustment of the size and placement of the openings **416** allows adjustment of the cooling on the neck portion of the injected preform, thereby allowing adjustment of the crystallinity and crystallinity gradient in the neck portion.

[0195] **FIG. 19** is a schematic representation of another embodiment of a mandrel, or core **298"**, including a modified base end **322** or tip. The mold core **298"** of **FIG. 19** is similar in construction to the mold described above with reference to **FIG. 15**. Accordingly, like reference characters will be used to describe like components, except that a (") will be used to denote modified components.

[0196] As described above, the end cap portion of the injection molded preform adjacent the base end **322**, receives the last portion of the melt stream to be injected into the mold cavity **300**. Thus, this portion is the last to begin cooling. If the PET layer has not sufficiently cooled before the overmolding process takes place, the force of the barrier material melt entering the mold may wash away some of the PET near the base end **322** of the core **298**. To speed cooling in the base end **322** of the core **298** in order to decrease cycle time, the modified core **298"** includes a base end **322"** portion constructed of an especially high heat transfer material, preferably a beryllium-free copper alloy, such as AMPCOLOY. Advantageously, the AMPCOLOY base end **322"** allows the circulating fluid C to withdraw heat from the injected preform at a higher rate than the remainder of the core **298"**. Such a construction allows the end cap portion of the preform to cool quickly, in order to decrease the necessary cooling time and, thus, reduce the cycle time of the initial preform injection.

[0197] The modified core **298"** illustrated in **FIG. 19** generally comprises an upper core portion **418**, substantially as illustrated in **FIG. 15**, and a base end portion **322"** constructed of a high heat transfer material, including, but not limited to, a beryllium-free copper alloy, such as AMPCOLOY. A core tube **332**, substantially as described above, is illustrated in phantom. As in **FIG. 15**, the present core tube **332** is operable for delivering circulating cooling fluid to the base end **322"** of the core **298"**.

[0198] The core **298"** is substantially hollow and defines an inner diameter D and wall thickness T. The upper core portion **418** includes a recessed step **420** having a diameter D_S which is greater than the inner diameter D of the core **298"**. The base end portion **322"** includes a flange **422** having a diameter D_F which is smaller than the diameter D_S of the step **420**. The difference between the diameters D_S and D_F of the step **420** and flange **422**, respectively, is preferably between 0.000 and 0.025 inches. More preferably, the difference is between 0.010 and 0.015 inches. When the base end portion **322"** is placed concentrically within the upper core portion **418**, the difference in the diameters D_S, D_F results in a gap G being formed between the base end and upper core portions **322"**, **418**. The width W of the gap G is approximately equal to one-half the difference between the diameters D_S, D_F. Additionally, the base end portion **322"** is preferably about 0.750-1.250 inches in length.

[0199] Preferably, the modified core **298"** is constructed by starting with an unmodified core **298** made from a single material, substantially as illustrated in **FIG. 15**. The end portion, or tip, of the unmodified core **298** is cut off approximately at the point where the high heat transfer base end **322"** is desired to begin. A drilling, or boring, tool may then be inserted from the end portion of the core **298"** to ensure that the inner diameter D is correctly sized and concentric with a center axis of the core **298"**. This also ensures that the wall thickness T is consistent throughout the portion of the core **298"** which is in contact with the injected preform, thus ensuring that the cooling of the preform is consistent as well. Such a method of construction presents a distinct advantage over conventionally formed cores. In a conventional core, because the length to diameter ratio is large, the drilling tool used to create the hollow inner portion of the core often tends to wander, that is, tends to deflect from the center axis of the core. The wandering of the

drilling tool results in a core having an inconsistent wall thickness and, thus, inconsistent heat transfer properties. With the above-described method of sizing the inner diameter D from the base end of the core **298"**, the problem of tool wandering is substantially reduced or eliminated. Therefore, a consistent wall thickness T and, as a result, consistent heat transfer properties are achieved.

[0200] The upper core portion **418** and base end portion **322"** are preferably joined by a silver solder process. AMPCOLOY is a preferred material for the base end portion **322"** in part because it contains some silver. This allows the silver solder process to provide a joint of sufficient strength to be useful in injection molding applications. Preferably, the soldering process results in a full contact joint. That is, solder material is disposed on all of the mating surfaces (**424, 426** and gap G) between the upper core portion **418** and base end portion **322"**. Advantageously, the provision of the gap G enhances the flow of solder material such that a strong joint is achieved. In addition, the full contact joint is advantageous because it provides for consistent heat transfer properties and high strength. If the soldered joint was not a full contact joint, any air present in the gap G would result in inconsistent heat transfer through the gap G portion of the core **298"**. Although it is preferred to join the upper core portion **418** and base end portion **322"** with a silver solder process, other suitable joining processes may also be used.

[0201] As illustrated in **FIG. 19**, the base end portion **322"** of the modified core **298"** is preferably of a larger size than the final dimension desired (illustrated by the dashed line **428**) when it is joined to the upper core portion **418**. Advantageously, this allows for the base end portion **322"** to be machined to its desired dimension after assembly to the upper core portion **418** in order to ensure a proper final diameter and a smooth surface at the transfer from the upper core portion **418** to the base end portion **322"**.

[0202] Another way to enhance cooling of the preform's gate area was discussed above and involves forming the mold cavity so that the inner PET layer is thinner at the gate area than at the rest of the injected preform as shown in **FIG. 4**. The thin gate area thus cools quickly to a substantially solid state and can be quickly removed from the first mold cavity, inserted into the second mold cavity, and have a layer of barrier material injected thereover without causing washing of the PET.

[0203] In the continuing effort to reduce cycle time, injected preforms are removed from mold cavities as quickly as possible. However, it may be appreciated that the newly injected material is not necessarily fully solidified when the injected preform is removed from the mold cavity. This results in possible problems removing the preform from the cavity **300**. Friction or even a vacuum between the hot, malleable plastic and the mold cavity surface **304** can cause resistance resulting in damage to the injected preform when an attempt is made to remove it from the mold cavity **300**.

[0204] Typically, mold surfaces are polished and extremely smooth in order to obtain a smooth surface of the injected part. However, polished surfaces tend to create surface tension along those surfaces. This surface tension may create friction between the mold and the injected preform which may result in possible damage to the injected preform during removal from the mold. To reduce surface tension, the mold surfaces are preferably treated with a very fine sanding device to slightly roughen the surface of the mold. Preferably the sandpaper has a grit rating between about 400 and 700. More preferably a 600 grit sandpaper is used. Also, the mold is preferably sanded in only a longitudinal direction, further facilitating removal of the injected preform from the mold.

[0205] During injection, air is pushed out of the mold cavity **300** by the injected meltstream. As a result, a vacuum may develop between the injected preform and the mold cavity wall **304**. When the injected preform is removed from the cavity **300**, the vacuum may resist removal, resulting in damage to the not-fully-solidified preform. To defeat the vacuum, an air insertion system **340** may be employed. With additional reference to **FIGS. 16 and 17**, an embodiment of an air insertion system **340** is provided. At a joint **342** of separate members of the mold cavity **300**, a notch **344** is preferably formed circumferentially around and opening into the mold cavity **300**. The notch **344** is preferably formed by a step **346** of between 0.002 inches and 0.005 inches and most preferably about 0.003 inches in depth. Because of its small size, the notch **344** will not fill with plastic during injection but will enable air A to be introduced into the mold cavity **300** to overcome the vacuum during removal of the injected preform from the mold cavity **300**. An air line **350** connects the notch **344** to a source of air pressure and a valve (not shown) controls the supply of air A. During injection, the valve is closed so that the melt fills the mold cavity **300** without air resistance. When injection is complete, the valve opens and a supply of air is delivered to the notch **344** at a pressure between about 75 psi and 150 psi and most preferably about 100 psi. The supply of air defeats any vacuum that may form between the injected preform and the mold cavity, aiding removal of the preform. Although the drawings show only a single air supply notch **344** in the mold cavity **300**, any number of such notches may be provided and in a variety of shapes depending on the size and shape of the mold.

[0206] While some of the above-described improvements to mold performance are specific to the method and apparatus described herein, those of skill in the art will appreciate that these improvements may also be applied in many different types of plastic injection molding applications and associated apparatus. For instance, use of AMPCOLOY in a mold may quicken heat removal and dramatically decrease cycle times for a variety of mold types and melt materials. Also, roughening of the molding surfaces and provides air pressure supply systems may ease part removal for a variety of mold types and melt materials.

[0207] 2. Preferred Dip Coating Processes

[0208] One preferred method of producing a coated preform in accordance with preferred embodiments is to dip coat the preform in a resin-containing solvent bath. The dipping of the preforms into the resin-containing bath can be done manually by the use of a retaining rack or the like, or it may be done by a fully automated process which may include the blow-molding process at the end.

[0209] The bath contains a solution made from one or more solvents into which the resin of the barrier material is dissolved and/or suspended. The term "solution" as used herein refers to end result of mixing solvent(s) and resin, whether the resulting combination is in solution, suspension, or some combination thereof. The resin may be used in any

form, but as with most all materials, smaller sized particles go into solution faster than larger ones. If the barrier material is not very soluble in a given solvent, adding the resin as a powder will help create a more uniform suspension. A wide variety of solvents may be used, as well as solvent systems made of combinations of solvents. Preferred solvents include dimethylformamide (DMF), ethanol, tetrahydrofuran (THF), methylene chloride, water, acetone, benzene, toluene, Dowanol DPM, Dowanol PPH, and Dowanol PM, and mixtures thereof. Factors which influence the selection of solvent or solvent system include polarity, reactivity, solubility, boiling point, vapor pressure, and flammability. The dip-coating solutions of the present invention preferably contain 10-60% resin by weight, more preferably 20-50% resin by weight, most preferably 30-40% resin by weight. The temperature of the solution in the bath is preferably 0 to 100° C., more preferably 25 to 50° C. For PHAE materials, such as BLOX 0005, the solutions or dispersions used for dipping the preforms may be acidified solutions including those described in U.S. Pat. No. 6,180,715, which is hereby incorporated by reference in its entirety.

[0210] The surface of the preform to be dipped is preferably free of any oils, surfactants, mold release agents, or the like so that the barrier coating material can adhere directly to the outer surface thereof. The preforms are then dipped into the solution in the bath. The preform is preferably dipped until at least the entire body portion **4** of the preform is submerged in the bath up to just under the support ring **6**. The preform remains submerged in the bath preferably for 1 to 30 seconds, more preferably 2 to 5 seconds. The preform is then withdrawn from the bath and dried until no solvent remains on the preform. Drying may be done by any one of a number of methods, such as air-drying or placing the preforms under a vacuum and/or in a heated atmosphere as in an oven. The choice of method may depend upon the solvent chosen and the speed at which one desires the drying to take place. Additional dipping and drying steps may be done to create additional layers if desired. Preferably, further processing such as blow molding is done after the preform is dry.

[0211] Although the discussion above is in terms of preforms, the dipping process may also be done on bottles. The thickness of the barrier coating on the bottle or preform is preferably 0.01 to 3 mm, more preferably 0.1 to 1 mm.

[0212] In an exemplary process, a sample of a Phenoxy-type Thermoplastic resin, specifically a PHAE available from Dow Chemical Company as XU19040.00L was obtained as small pellets. The pellets were dissolved in dimethylformamide to a concentration of 40% by weight. Eight identical 17.5 g virgin PET preforms of the type used to make a 16 oz. carbonated beverage bottle were placed in a rack and dipped into the bath containing the resin/DMF solution which was at room temperature (approximately 21-23° C.). After 5 seconds the preforms were removed from the bath and dried for 8 hours in an oven set at about 75° C.

[0213] Before dip-coating, the preforms weighed an average of 17.5 grams. After dip-coating the preforms weighted an average of 18.0 grams, having had 0.5 grams of resin coated thereon by the process.

[0214] 3. Preferred Spray Coating Processes

[0215] Another method of producing coated articles, or providing additional coating layers, is by spray coating. In this method, the preforms or containers are sprayed with a solution of resin dissolved or suspended in a solvent. The spraying of the articles can be done manually or by use of an apparatus which provides for spraying and perhaps also post-spray treatment in one machine.

[0216] The solution or dispersion which is sprayed onto the articles contains one or more solvents into which the resin of the barrier material is dissolved and/or suspended. The solutions and dispersions mentioned above in reference to dip coating are preferably also used for spray coating. The solutions preferably contain 5 to 50% resin by weight, more preferably 30-40% resin by weight.

[0217] One preferred method of spray coating articles is based on the use of an apparatus such as that disclosed in U.S. Pat. No. 4,538,542 to Kennon, et al. (incorporated herein in its entirety by this reference) and sold by Nordson Corporation (Amherst, Ohio). This apparatus comprises a spray coating chamber, a drying chamber, and a conveyor for moving the preforms between the two chambers. The apparatus may further comprise an overspray recovery system.

[0218] During a preferred spray coating process, the neck portion of each article is clasped by an attachment means and mounted on a conveyor. The articles are evenly spaced apart on the conveyor. The articles are thus conveyed into the spray coating chamber wherein they pass in close proximity to a series of spray nozzles, preferably airless spray nozzles. The resin-containing solvent is sprayed through the nozzles so that it impacts the outside surface of each article as it passes through the chamber, leaving each article covered with a wet coating layer. To aid the adherence of the sprayed material and help hasten the evaporation of the solvent, the articles may be pre-heated by use of radiant heaters or other methods known to those skilled in the art before they enter the spray coating chamber.

[0219] The conveyor then carries the articles out of the spray coating chamber and into the drying chamber. The drying chamber may comprise an oven, a collection of lamps, or other source of thermal energy which provides the chamber with a temperature warm enough to aid in driving off the solvent in the wet coating layer, yet not so hot as to cause distortion in the shape of the article itself As the articles pass through the drying chamber, the solvent is evaporated, leaving a coating on the articles.

[0220] F. Formation of Preferred Containers by Blow Molding

[0221] The coated containers preferably produced by blow-molding the coated preforms, the creation of which is disclosed above. The coated preforms can be blow-molded using techniques and conditions very similar to those by which uncoated PET preforms are blown into containers. In other preferred embodiments in which it is desired for the entire container to be heat-set, it is preferred that the containers be blow-molded in accordance with processes generally known for heat set blow-molding, including, but not limited to, those which involve orienting and heating in the mold, and those which involve steps of blowing, relaxing and reblowing.

[0222] For example, for preforms in which the neck finish is formed primarily of PET, the preform is heated to a temperature of preferably 80 to 120° C., with higher tem-

peratures being preferred for the heat-set embodiments, and given a brief period of time to equilibrate. After equilibration, it is stretched to a length approximating the length of the final container. Following the stretching, pressurized air is forced into the preform which acts to expand the walls of the preform to fit the mold in which it rests, thus creating the container.

[0223] Although the present invention has been described herein in terms of certain preferred embodiments, and certain exemplary methods, it is to be understood that the scope of the invention is not to be limited thereby. Instead, Applicant intends that the scope of the invention be limited solely by reference to the attached claims, and that variations on the methods and materials disclosed herein which are apparent to those of skill in the art will fall within the scope of Applicant's invention.

What is claimed is:

1. An article comprising:

a neck portion, and a body portion; wherein

the neck portion and body portion are a monolithic first layer of material;

the neck portion is primarily crystalline; and

the body portion is primarily amorphous or semi-crystalline.

2. An article according to claim 1, wherein the neck portion is threaded.

3. An article according to claim 1, wherein the material is selected from the group consisting of PET homopolymers and copolymers, polyethylene naphthalate, polyethylene naphthalate copolymers, polyethylene naphthalate/polyethylene terephthalate blends, polyethylene terephthalate with PMDA, and combinations thereof.

4. An article according to claim 1, the body portion additionally comprising a wall portion defining a first thickness, and an end cap defining a second thickness, the first thickness being greater than the second thickness.

5. An article according to claim 1, wherein the body portion further comprises a second layer of material.

6. An article according to claim 5, wherein at least one of the first and second layers of material have barrier properties.

7. An article according to claim 5, wherein the second layer of material is a barrier material selected from the group consisting of Copolyester Barrier Materials, Phenoxy-type Thermoplastics, polyamides, Polyamide Blends, polyethylene naphthalate, polyethylene naphthalate copolymers, polyethylene naphthalate/polyethylene terephthalate blends, and combinations thereof.

8. An article according to claim 5, wherein the second layer of material is recycled or post-consumer PET.

9. An article according to claim 5, wherein the first layer of material comprises polyester and an oxygen scavenger and the second layer comprises recycled or post-consumer PET.

10. An article according to claim 5, further comprising a third layer of material disposed over the second layer of material.

11. An article according to claim 1, wherein a threaded neck finish thickness is defined from an exterior surface of the threaded neck finish to an interior surface of the threaded neck finish, the crystallinity being greater at the exterior surface than at the interior surface.

12. An article according to claim 1, wherein the interior surface of the threaded neck finish is amorphous or semi-crystalline.

13. An article according to claim 1, wherein the article is selected from the group consisting of bottles, preforms and containers.

14. A method of making a preform, comprising:

injecting a melt of a first material into a cavity formed by a mold and a core wherein the mold comprises a neck finish portion at a first temperature and a body portion at a second temperature, wherein the first temperature is greater than the crystallinity temperature of the first material and the second temperature is less than the crystallinity temperature of the first material;

leaving the melt of the first material in contact with the mold and core to form a preform wherein the body portion is primarily amorphous or semi-crystalline, and the neck finish is primarily crystalline; and

removing the preform from the mold.

15. A method as in claim 14, further comprising

dipping or spraying at least the body portion of the preform with a solution or dispersion of a second material to form a two-layer preform.

16. A method as in claim 14, further comprising

placing the preform in a second mold wherein the second mold comprises a body portion at a third temperature;

injecting a second layer of polymer melt over the body portion to form a two-layer preform; and

removing the two-layer preform from the mold.

17. A method as in claim 16, further comprising

dipping or spraying at least the body portion of the two-layer preform in a solution or dispersion of a third material to form a three-layer preform, wherein the third material is the same or different material from the first and second materials.

18. A method as in claim 17, wherein the third material comprises PHAE.

19. A method as in claim 16, further comprising blow-molding the preform to form a container or bottle.

20. A mold for making a preform, comprising:

a neck finish portion having a first mold temperature control system;

a body portion having a second temperature control system; and

a core having a third temperature control system;

wherein the first temperature control system is independent of the second and third temperature control systems and the neck finish portion is thermally isolated from the body portion and core.

21. A mold according to claim 20, wherein the first, second and third temperature control systems comprise circulating fluid.

22. A mold according to claim 20, wherein the first and second temperature control systems comprise components independently selected from the group consisting of heaters, heating coils, heating probes, and circulating fluid.

23. A mold according to claim 20, wherein the core comprises a first core portion in the region of the threaded neck portion of the mold and a second core portion in the region of the body portion of the mold, wherein the first and second core portions have separate temperature regulation systems.

24. A mold according to claim 23, wherein the first and second core temperature regulation systems are selected from the group consisting of heaters, heating coils, heating probes, and circulating fluid.

25. A mold according to claim 20, wherein the core has a base end, the core additionally comprising a core tube extending toward the base end of the core, the third temperature control system comprising circulating fluid, the fluid being introduced through the core tube to the base end of the core.

26. A mold according to claim 20, wherein the base end of the core is constructed from a material having a higher rate of heat transfer than an upper portion of the core.

* * * * *

EXHIBIT F

US 20020185212A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2002/0185212 A1**

Schaupp et al. (43) **Pub. Date: Dec. 12, 2002**

(54) **MACHINE FOR PLACEMENT OF MULTIPLE LABELS**

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(21) Appl. No.: **10/162,722**

(22) Filed: **Jun. 3, 2002**

Related U.S. Application Data

(60) Provisional application No. 60/295,098, filed on Jun. 1, 2001. Provisional application No. 60/309,679, filed on Aug. 2, 2001.

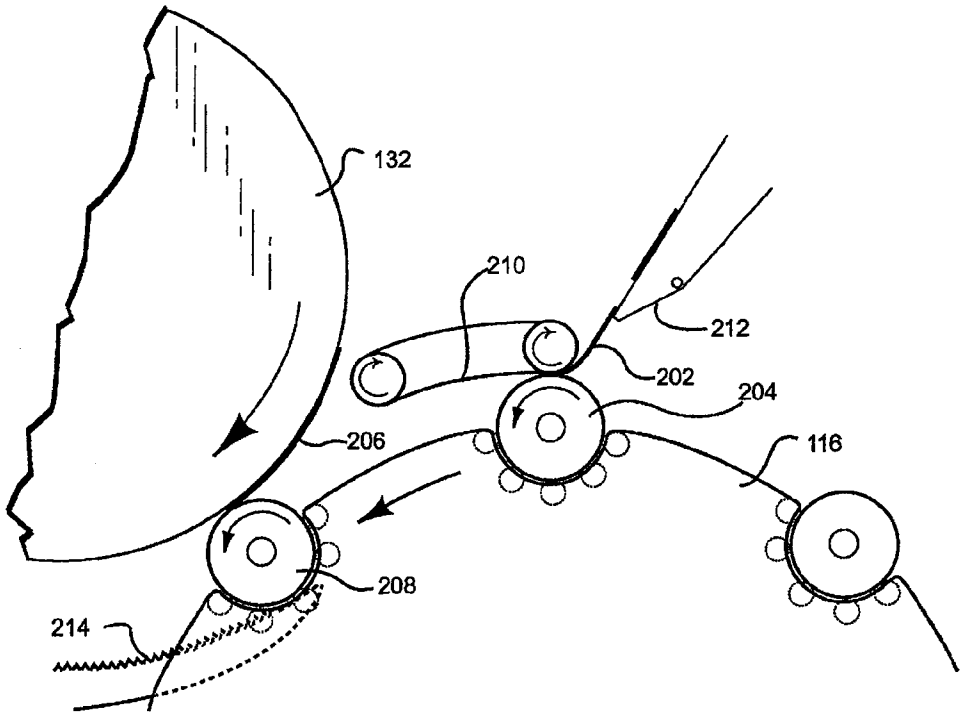
Publication Classification

(51) **Int. Cl.**[7] **B31F 1/22**

(52) **U.S. Cl.** **156/205**; 156/249; 156/541

(57) **ABSTRACT**

The present invention is a machine to perform two or more processes to an bottle wherein registration of the first process to the second process is required. The products produced with such registration have distinct advantages over prior art. These include labeling systems comprising multiple labels that can be incorporated into many useful variants for promotional items. Additionally, novel packaging systems can utilize this technology.



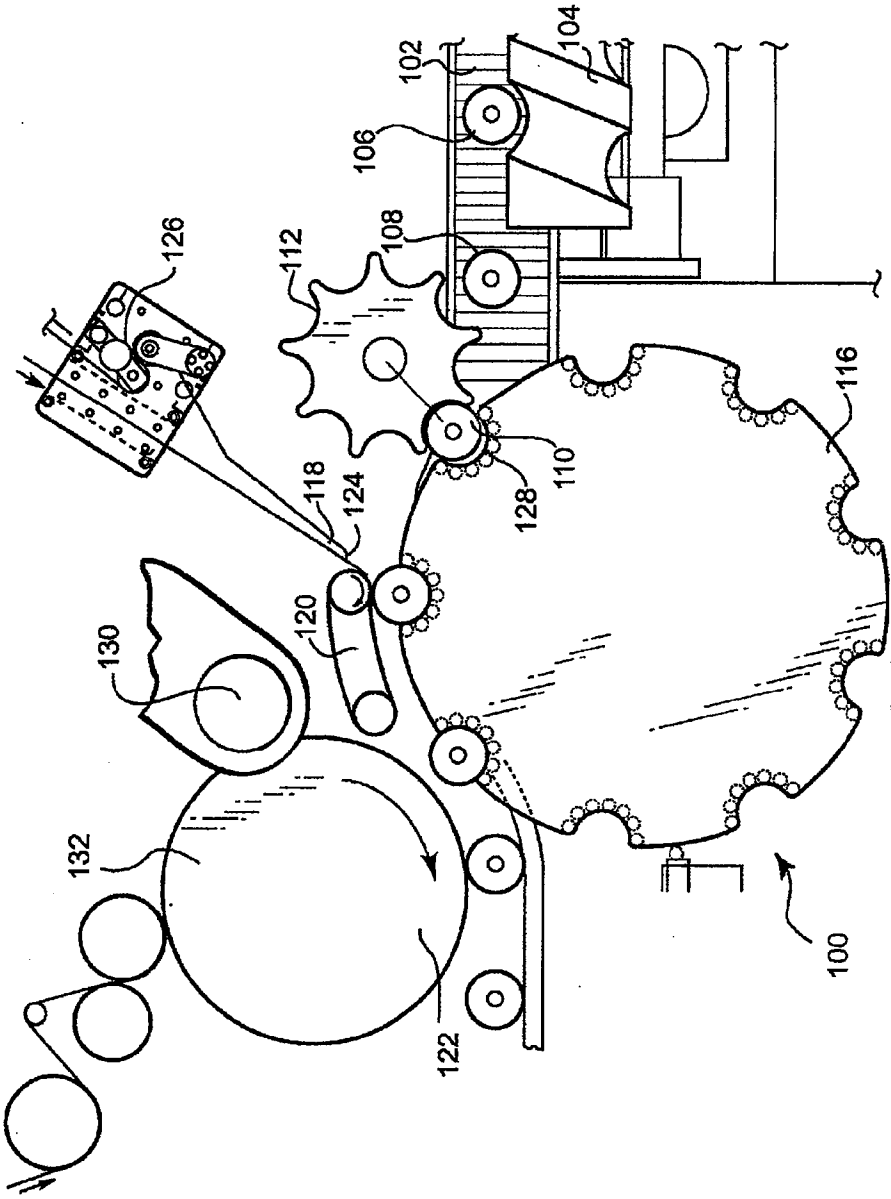


FIGURE 1

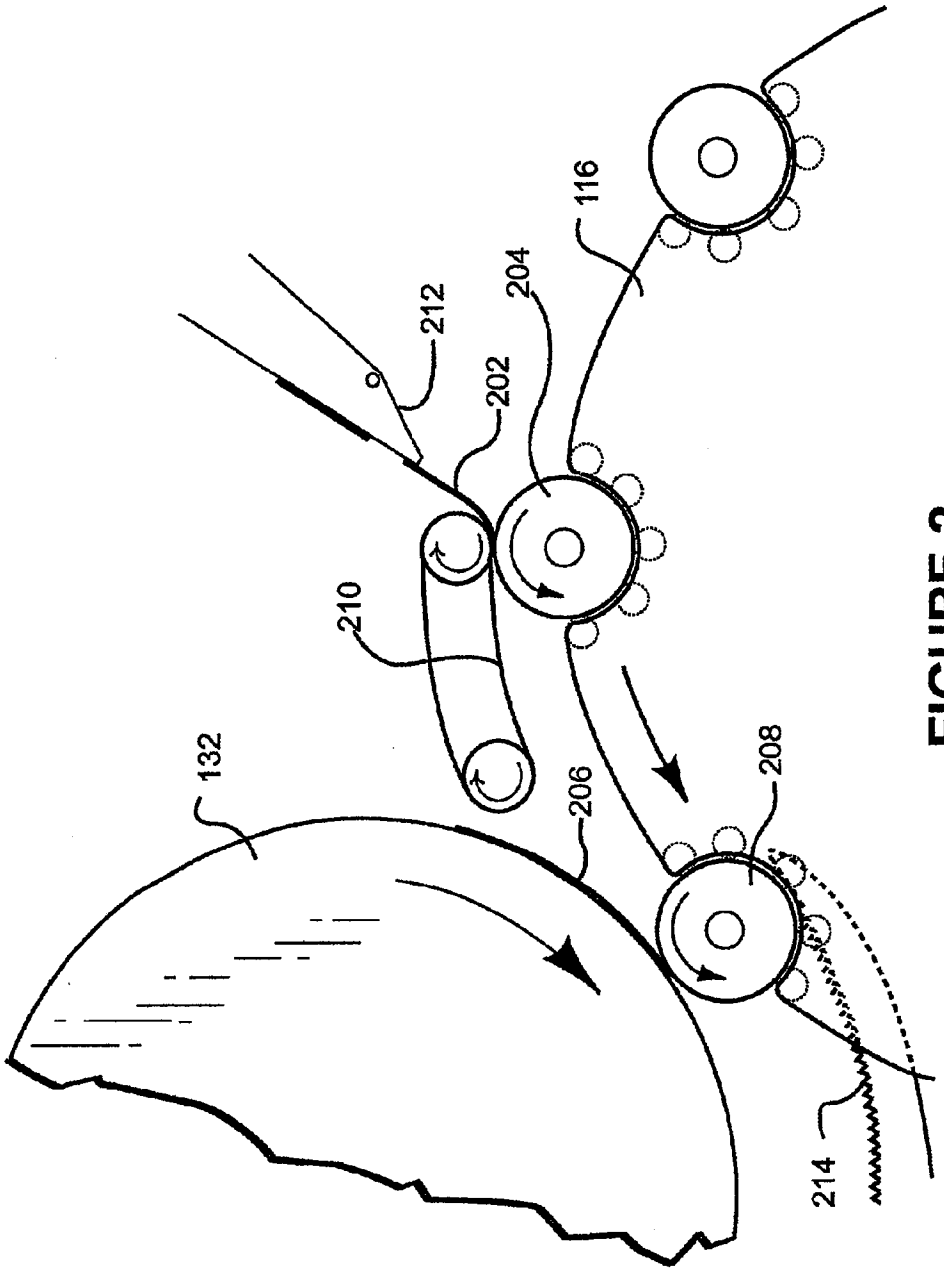


FIGURE 2

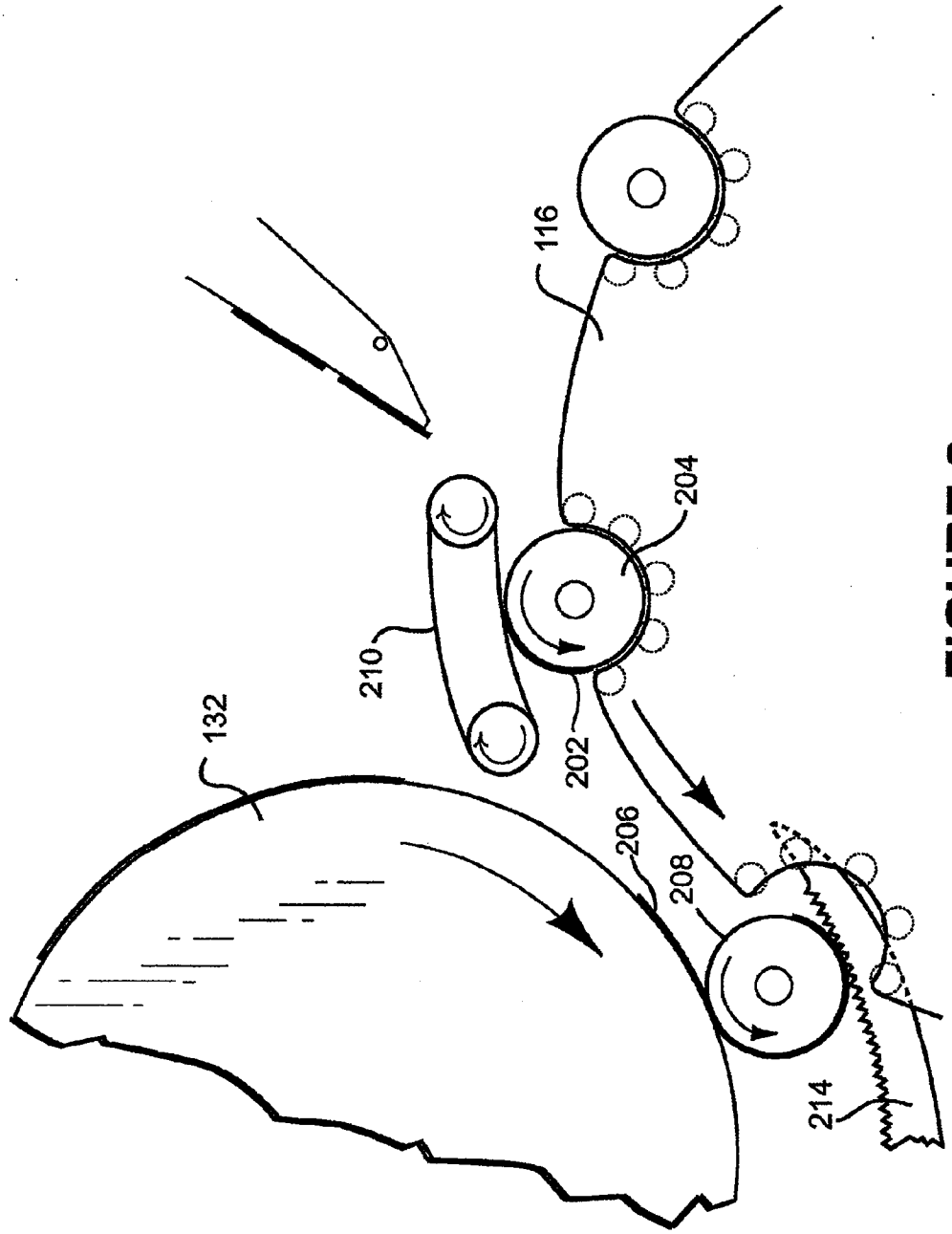


FIGURE 3

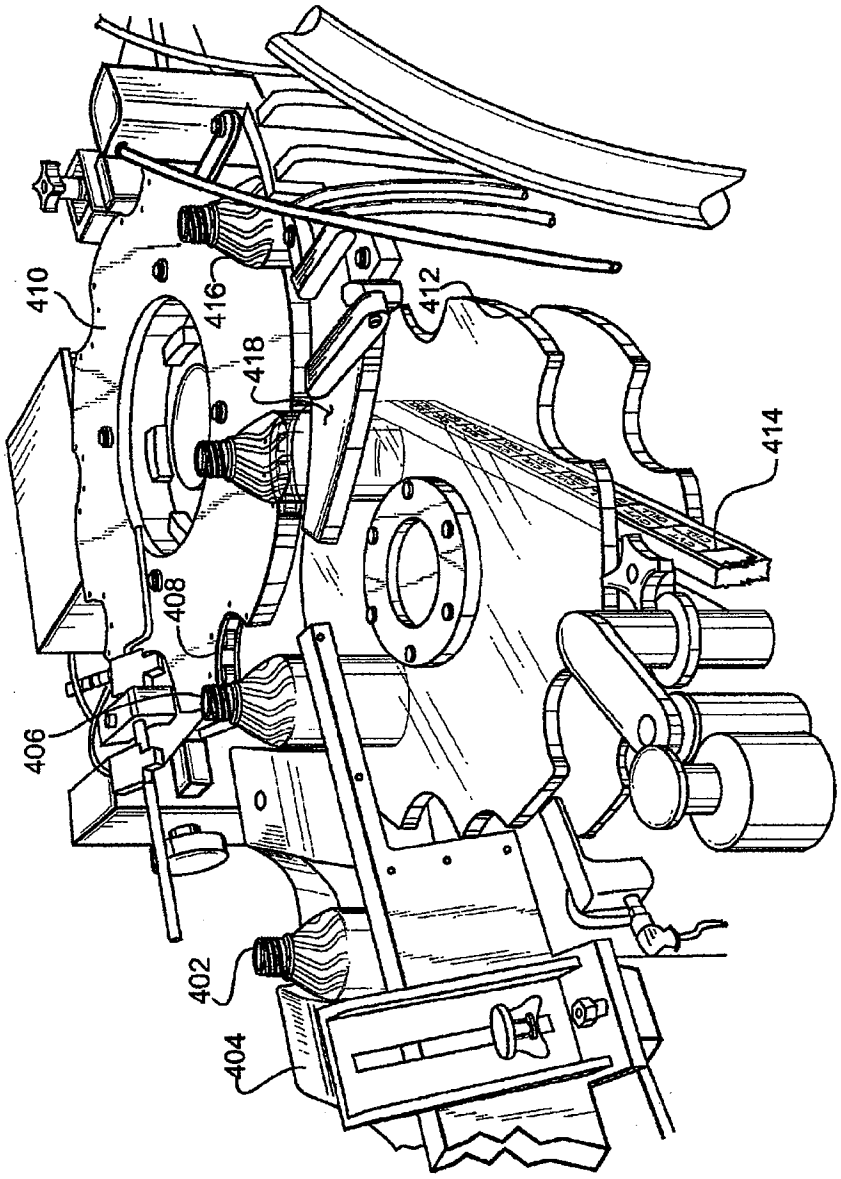


FIGURE 4

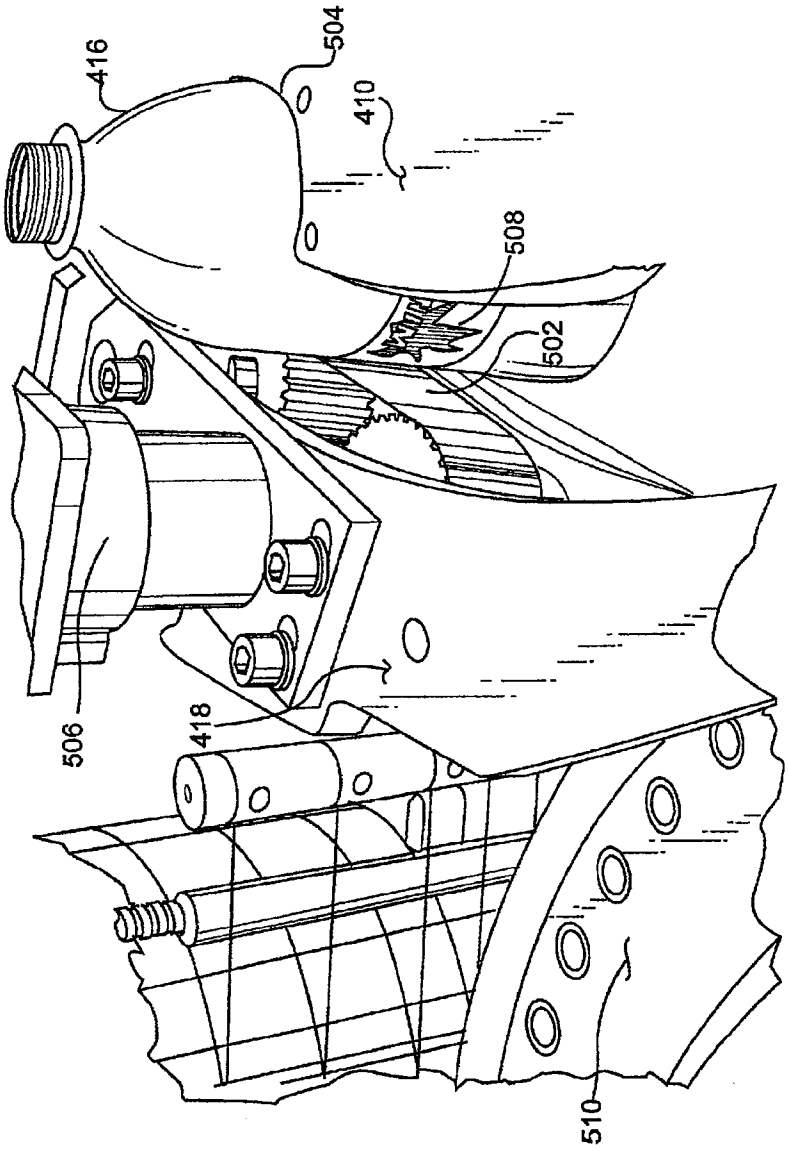


FIGURE 5

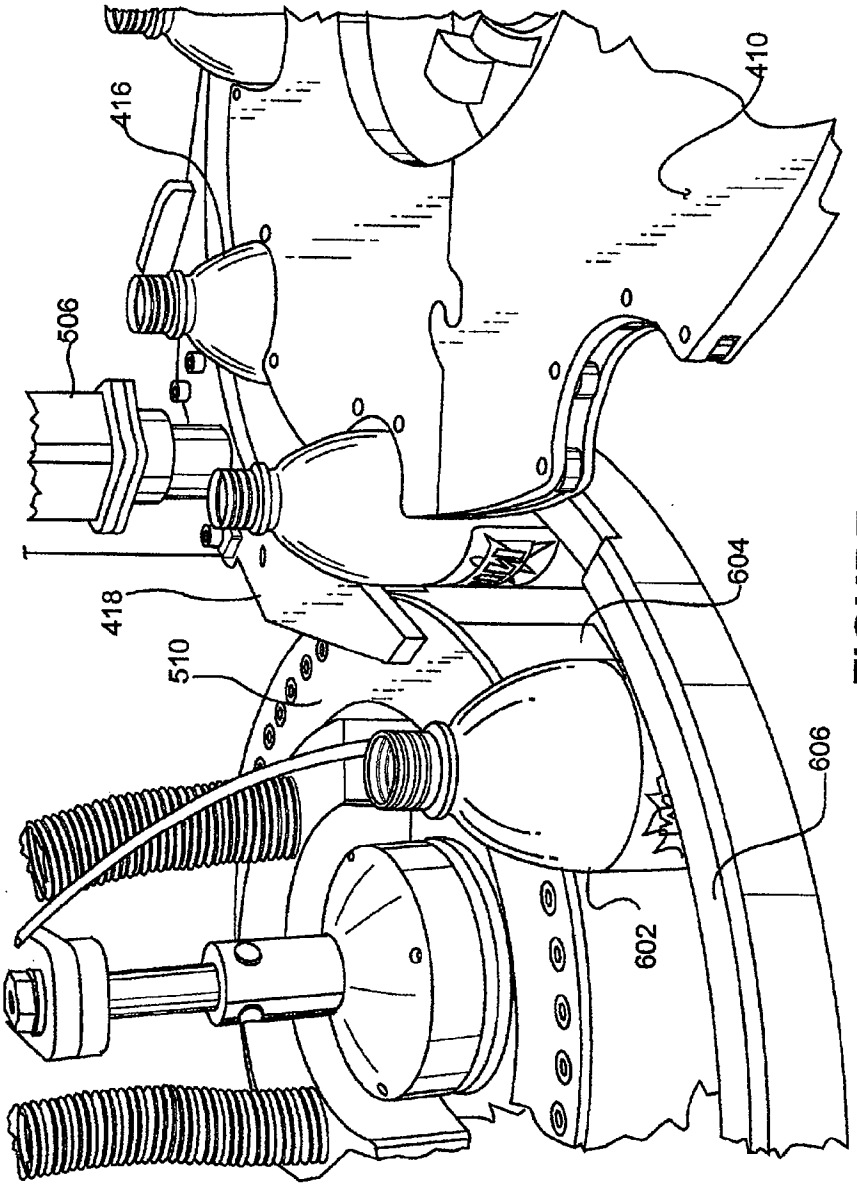


FIGURE 6

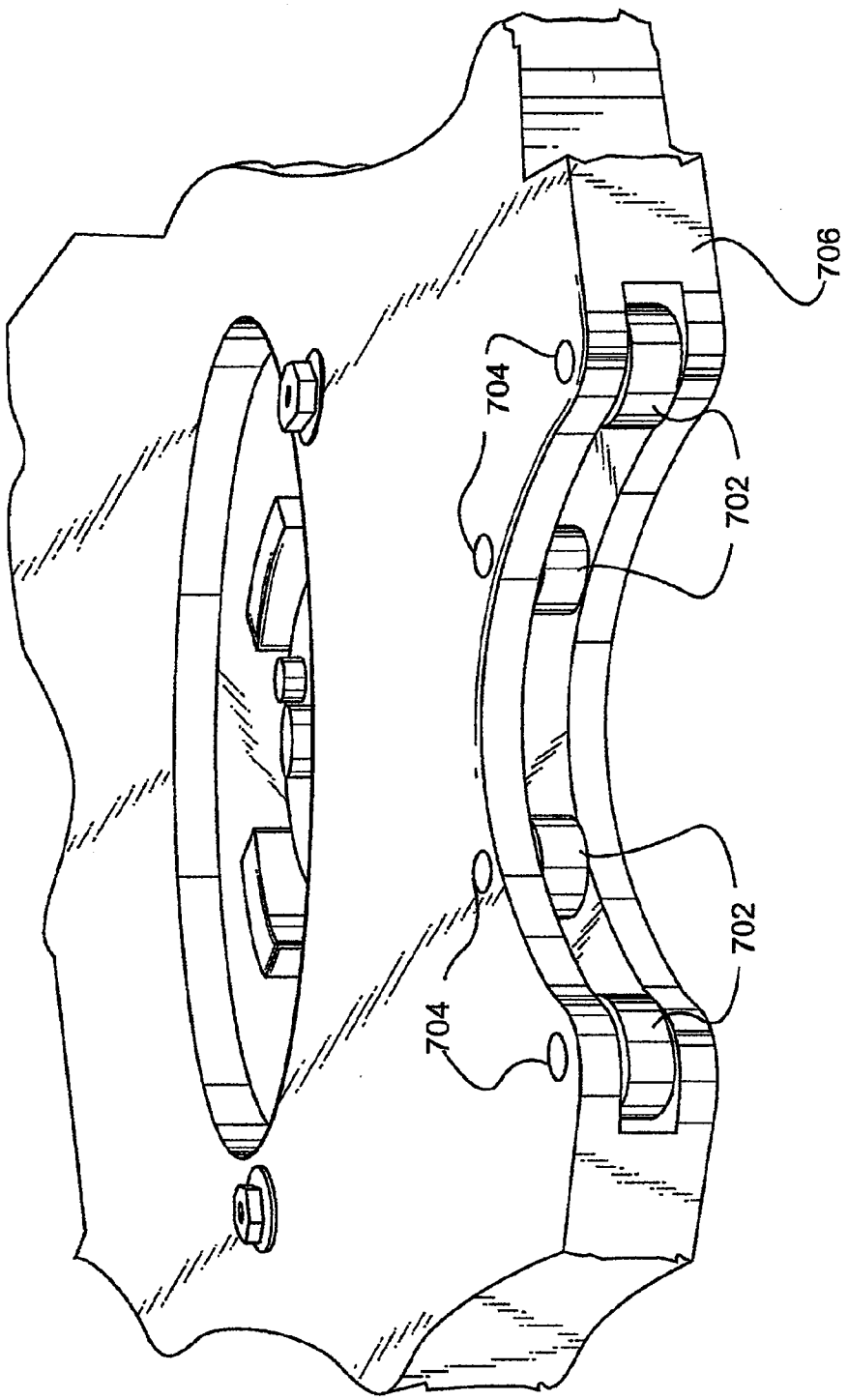


FIGURE 7

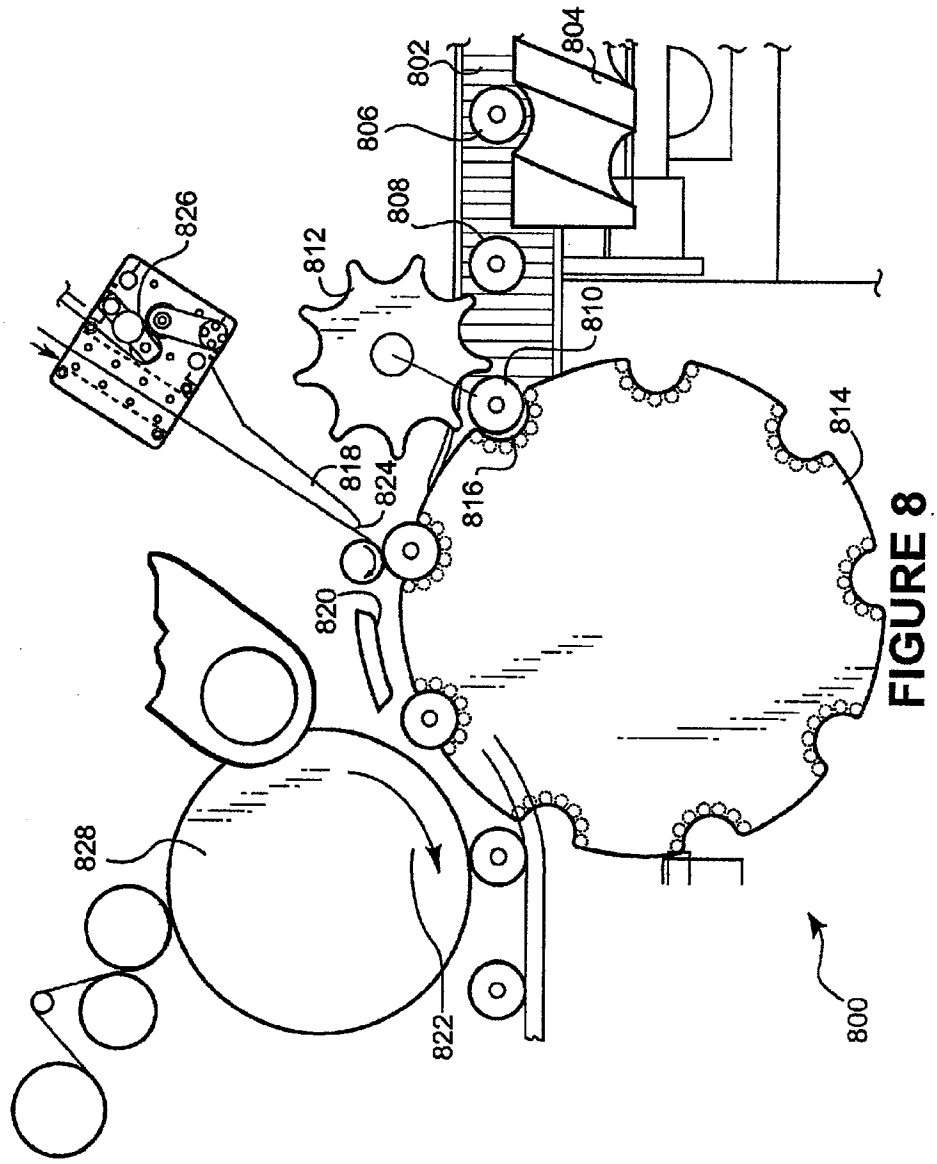


FIGURE 8

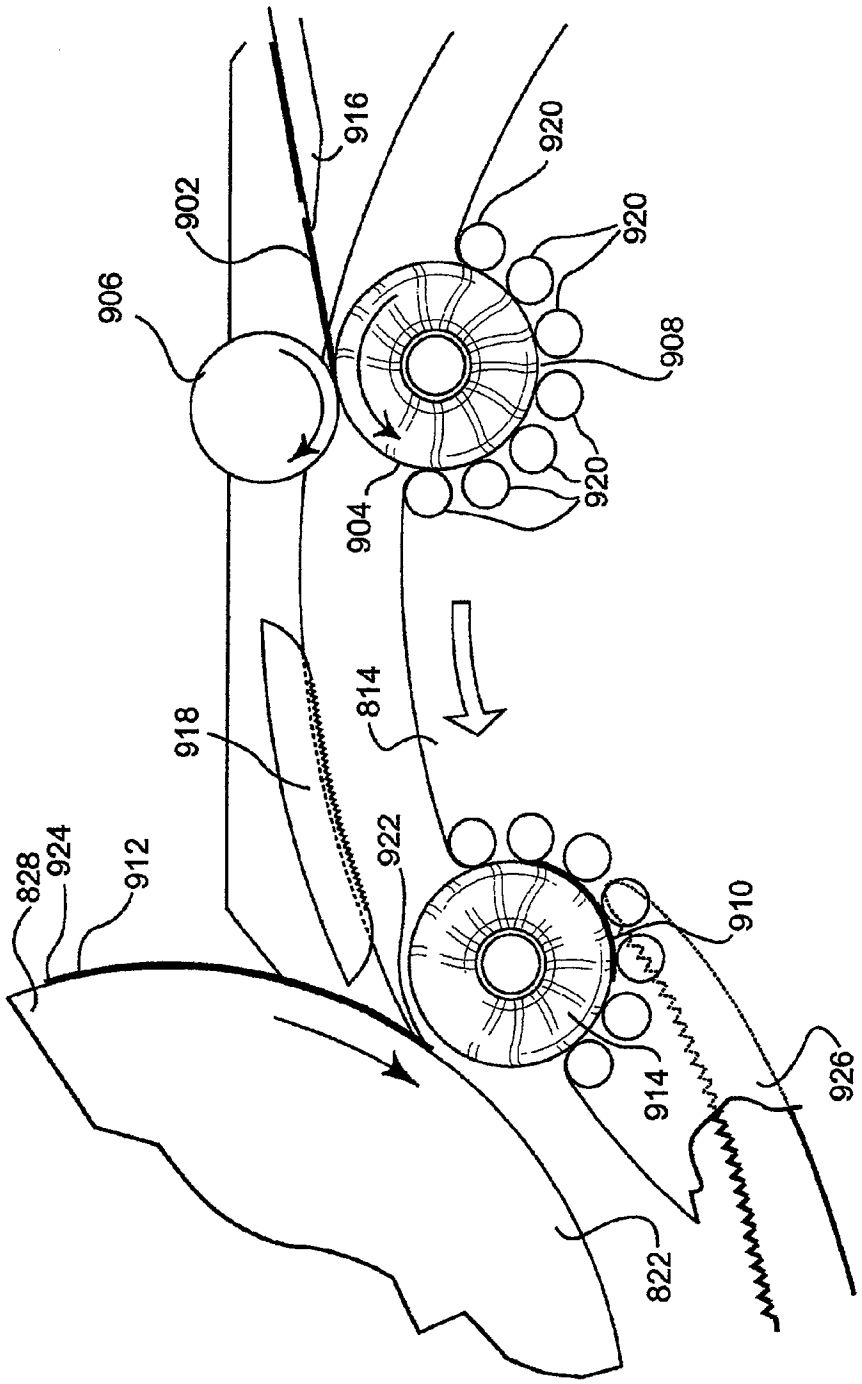

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FIGURE 9

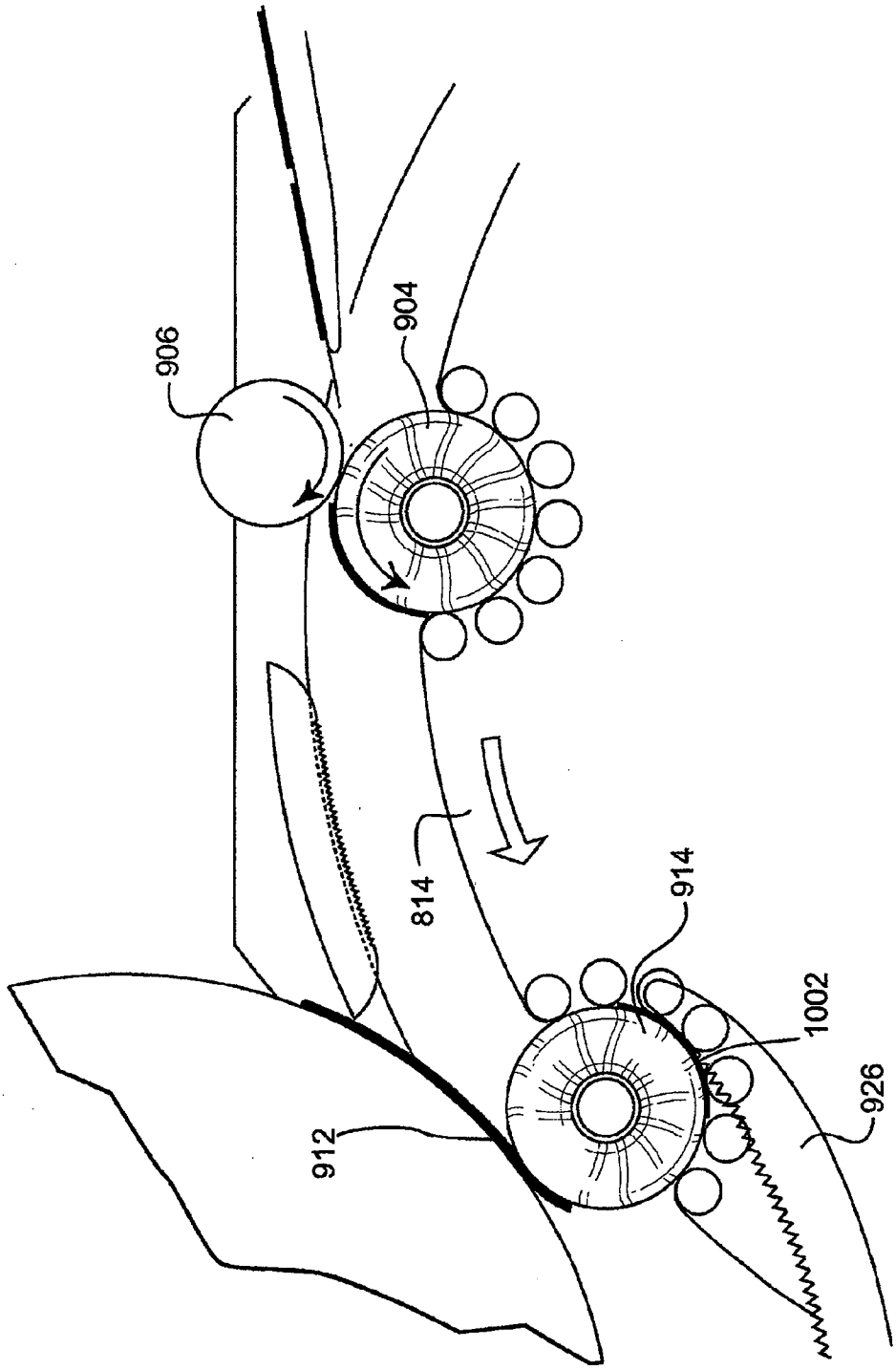


FIGURE 10

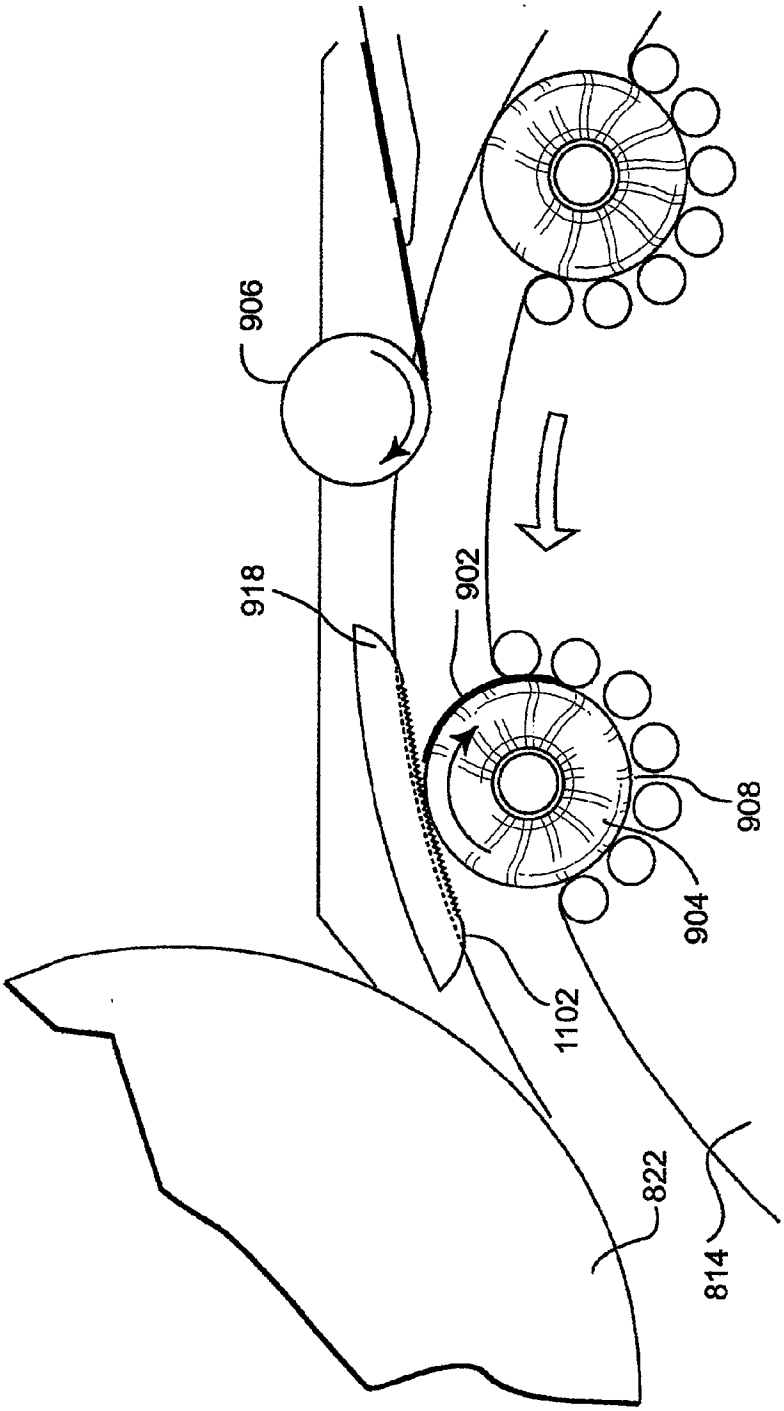


FIGURE 11

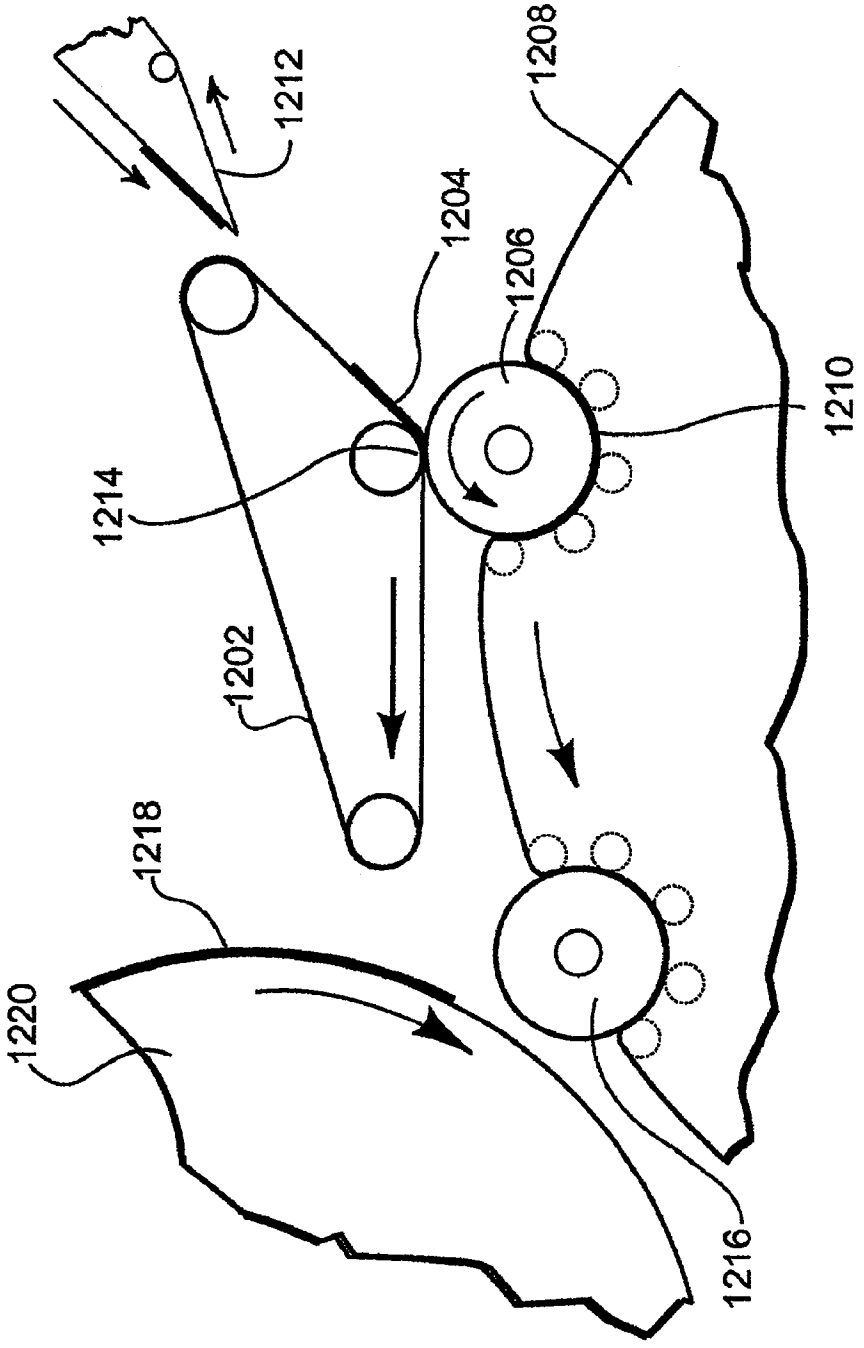


FIGURE 12

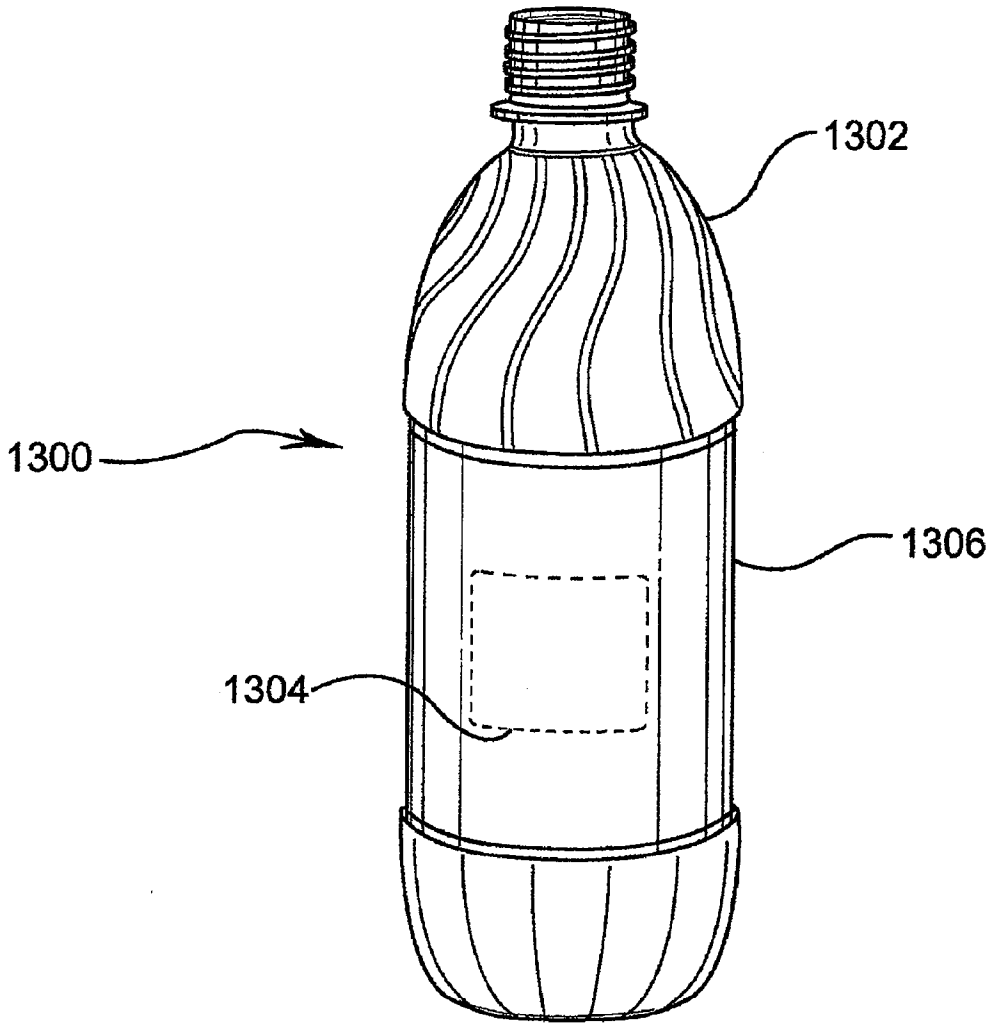
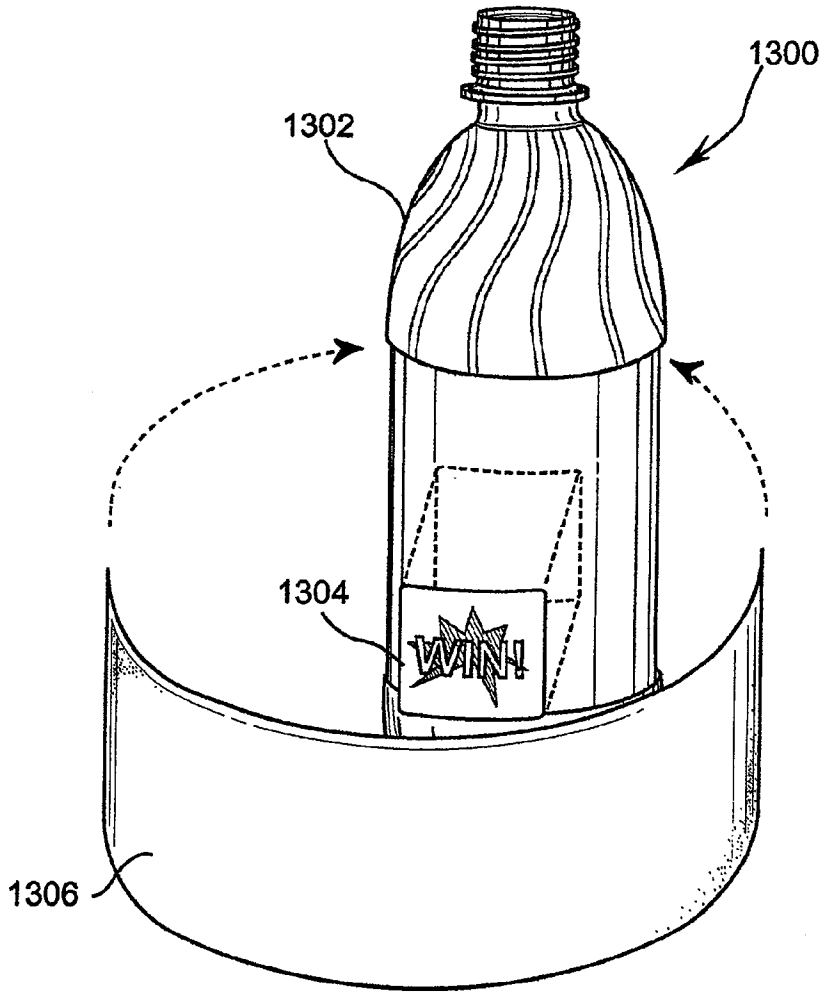


FIGURE 13



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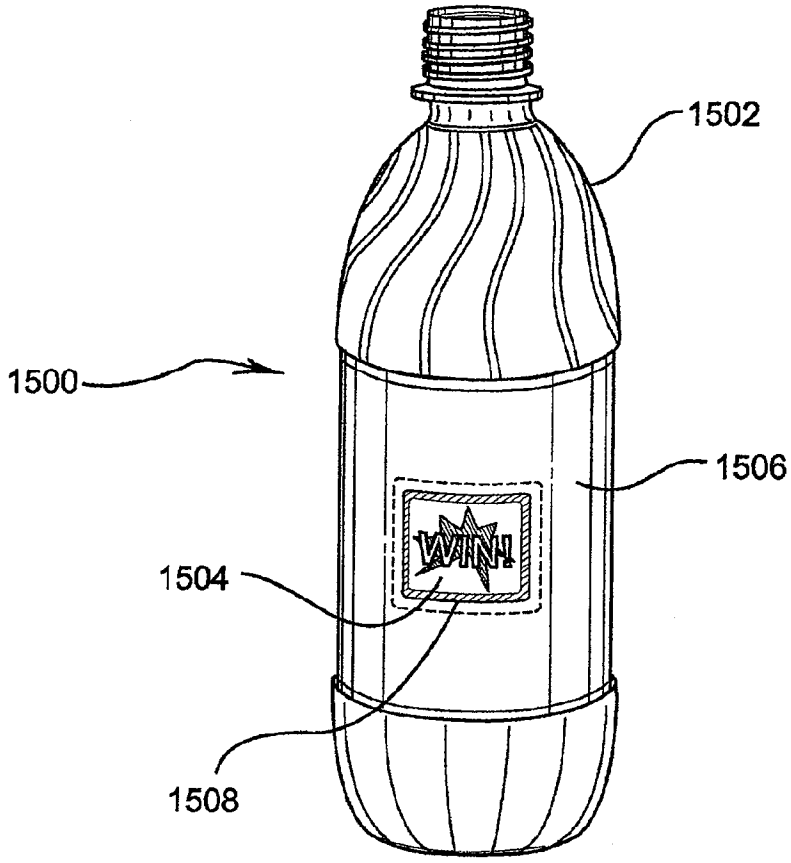


FIGURE 15

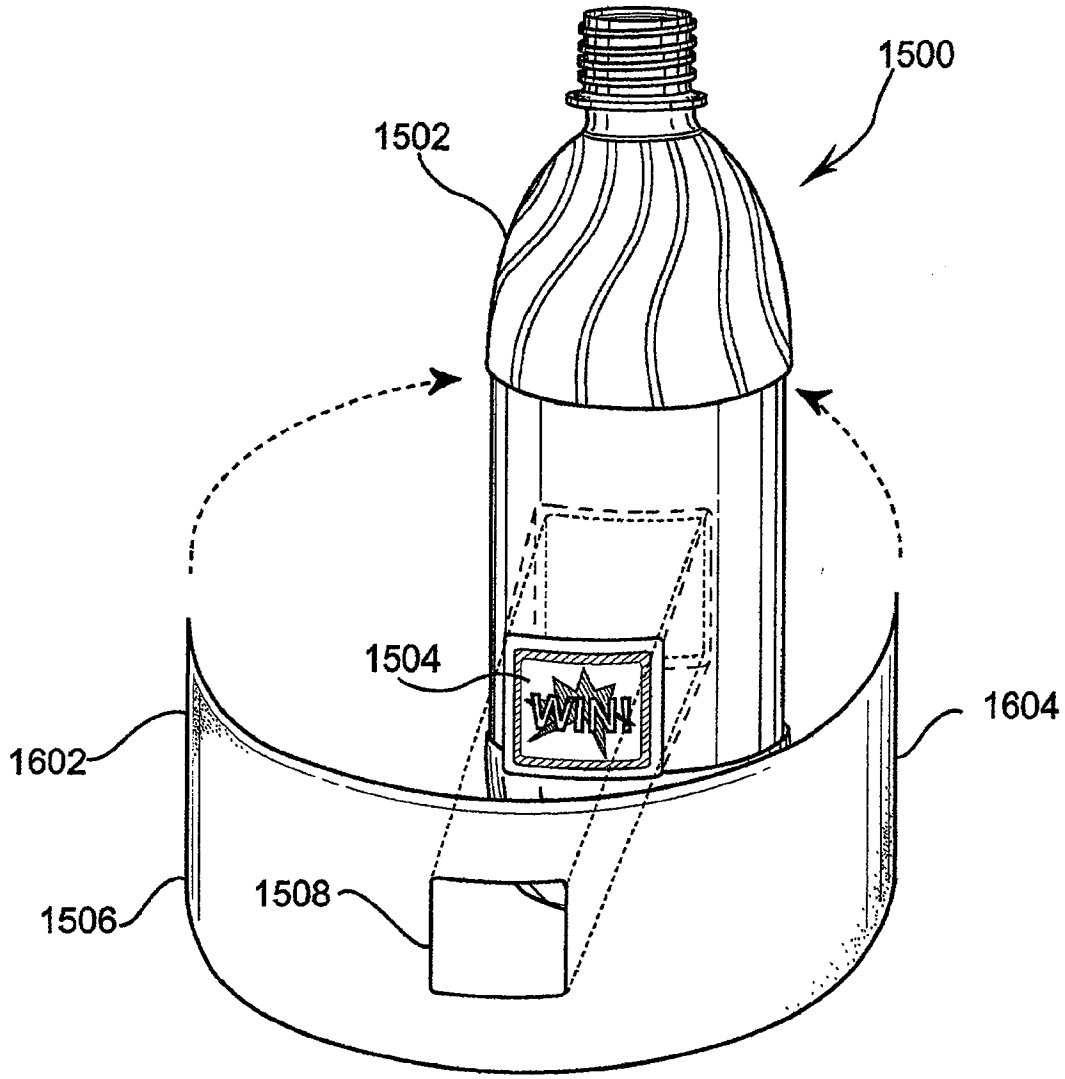
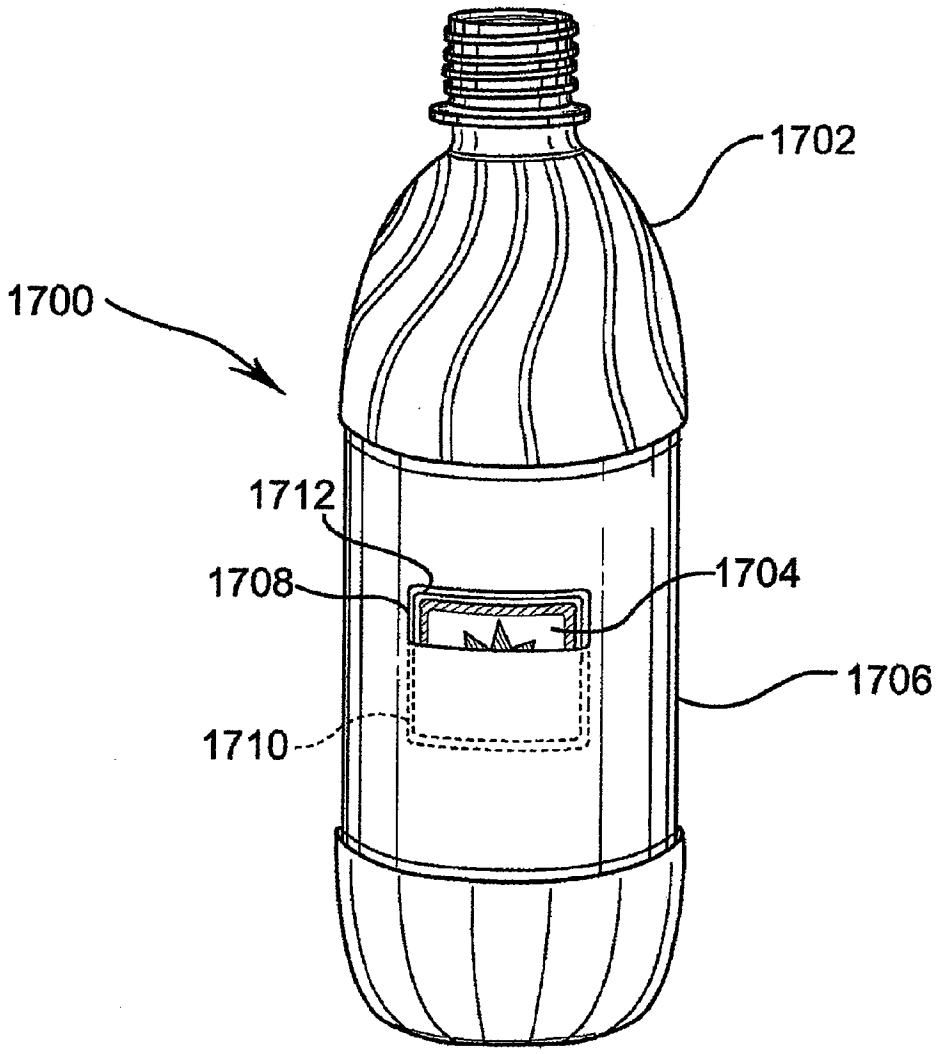


FIGURE 16



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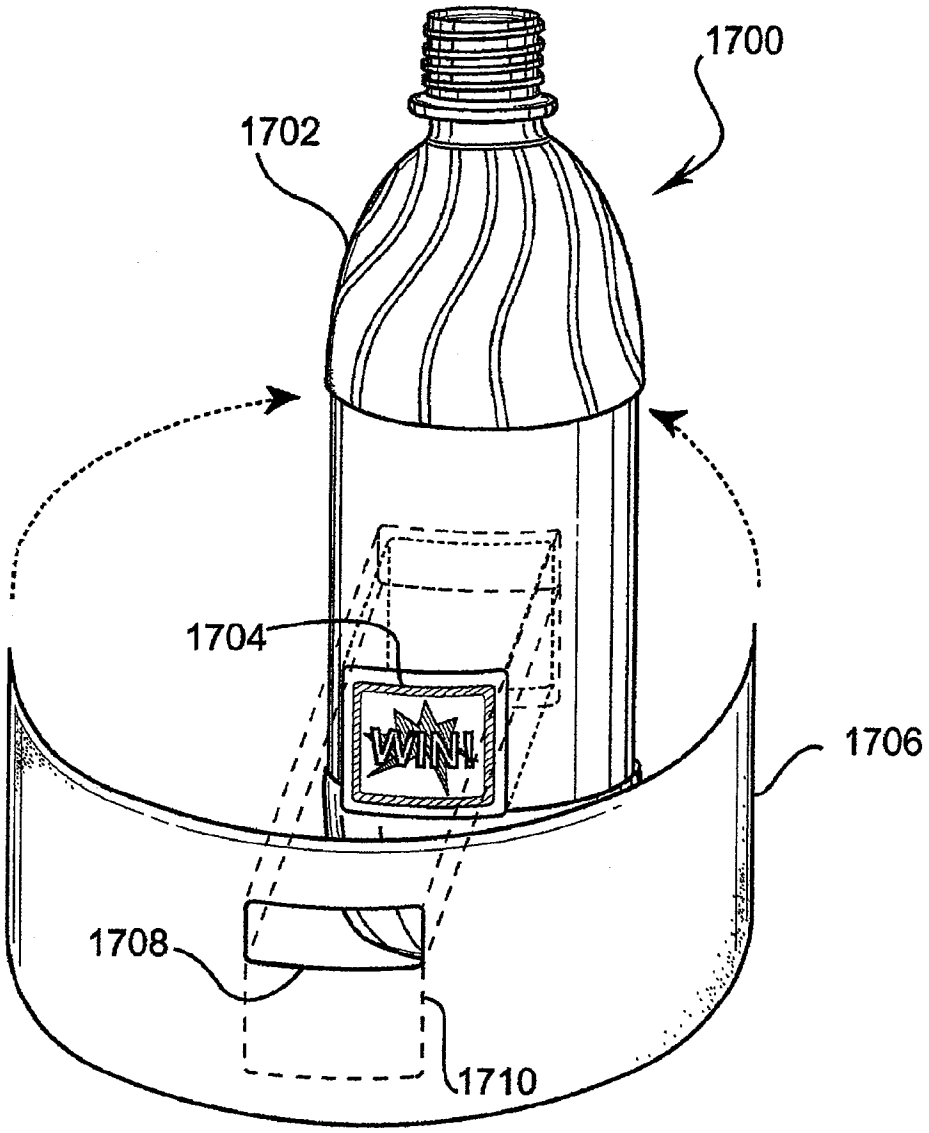

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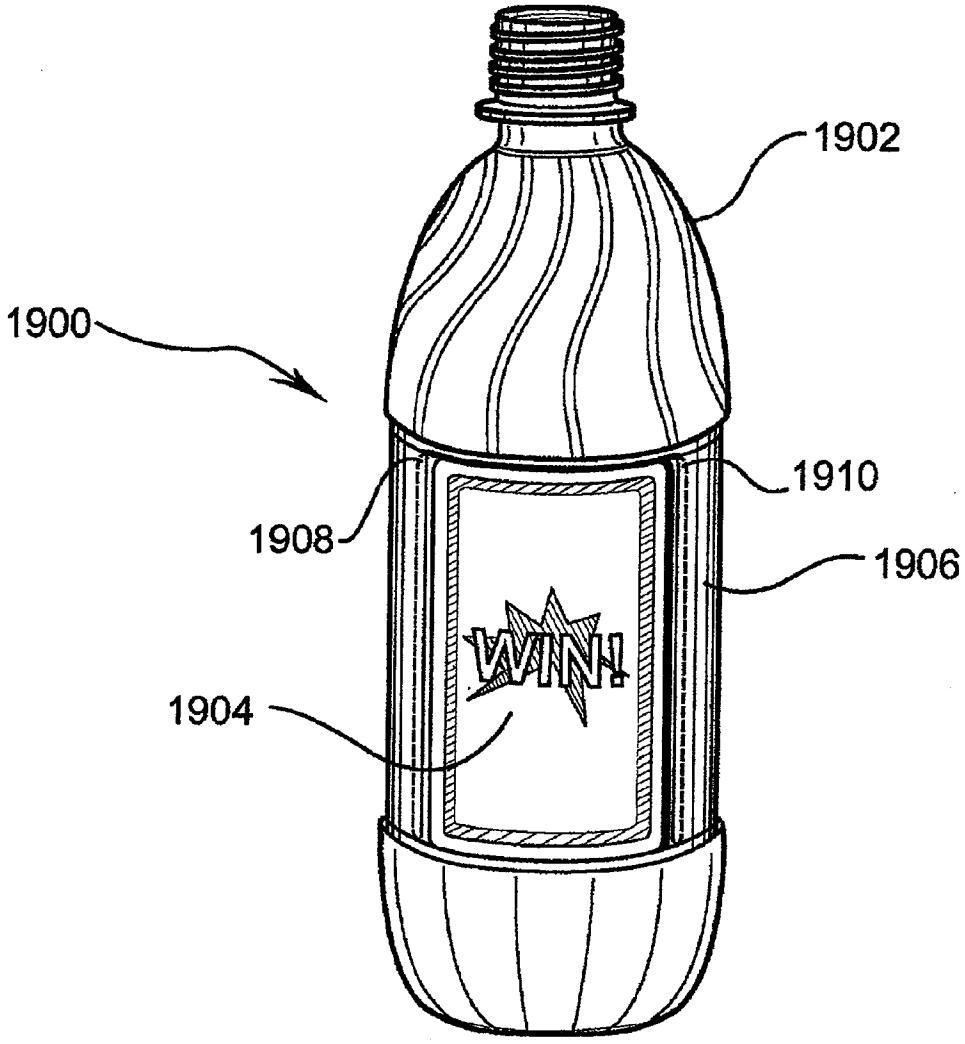

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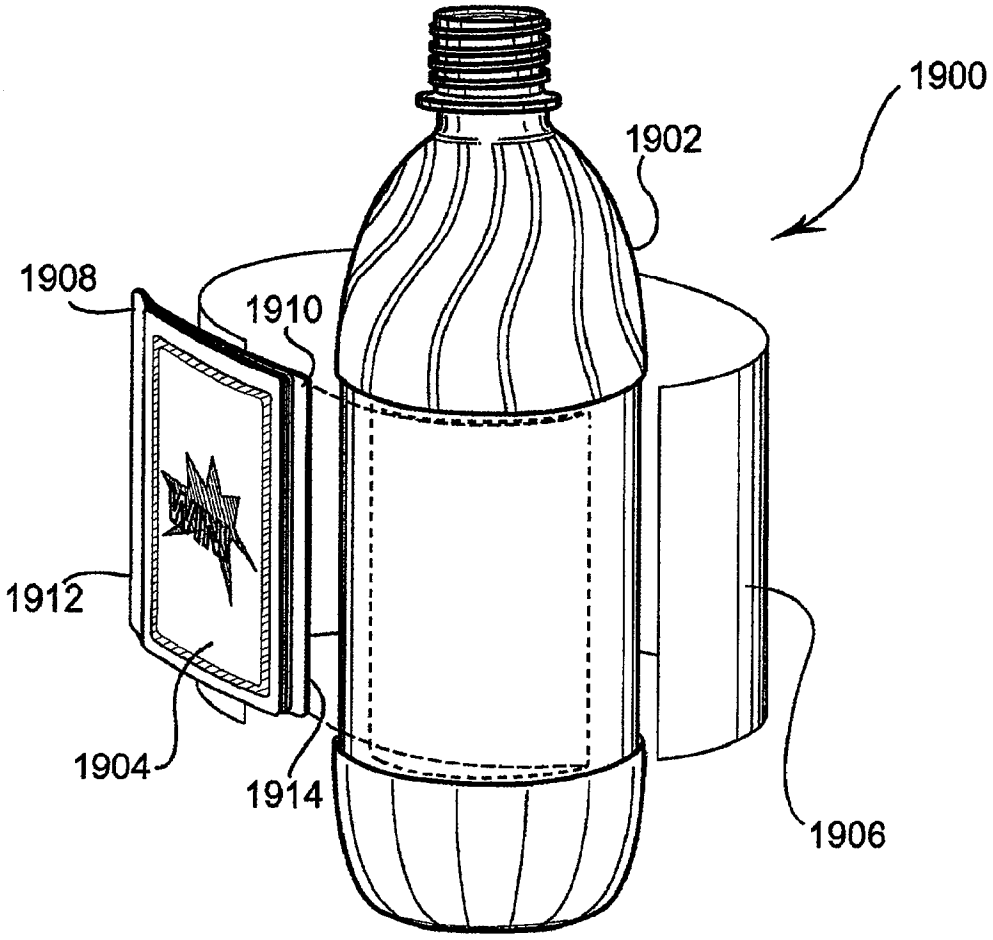

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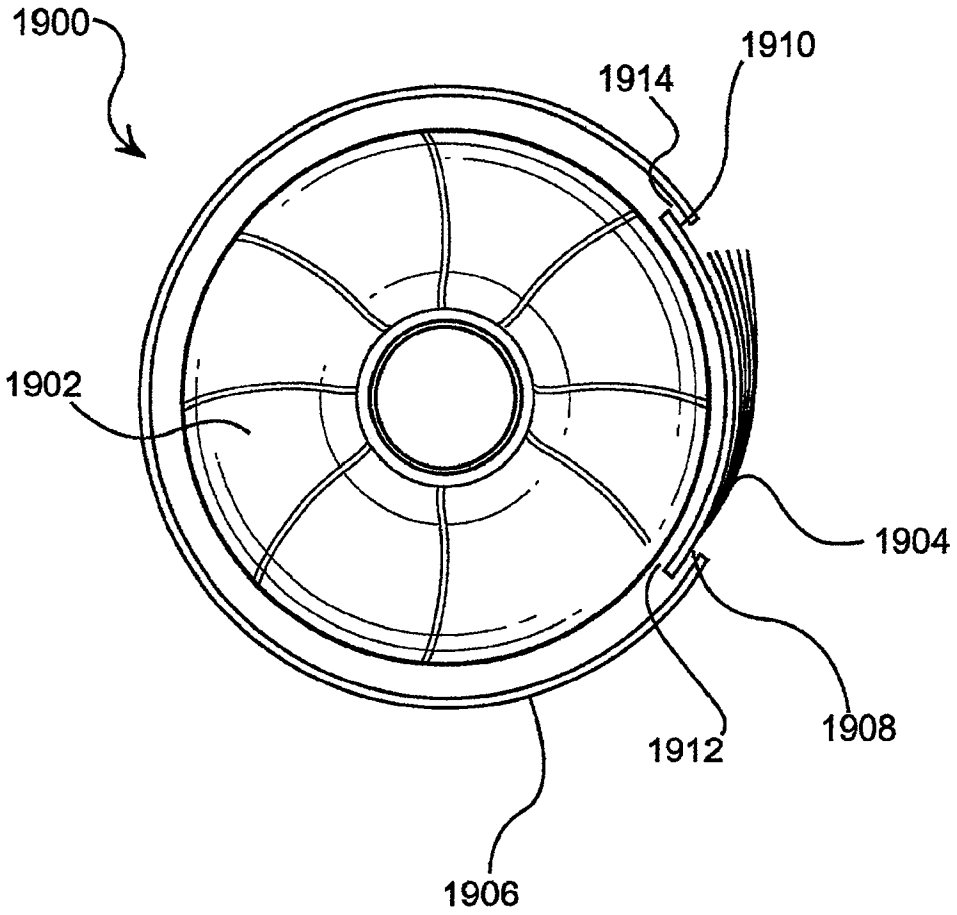

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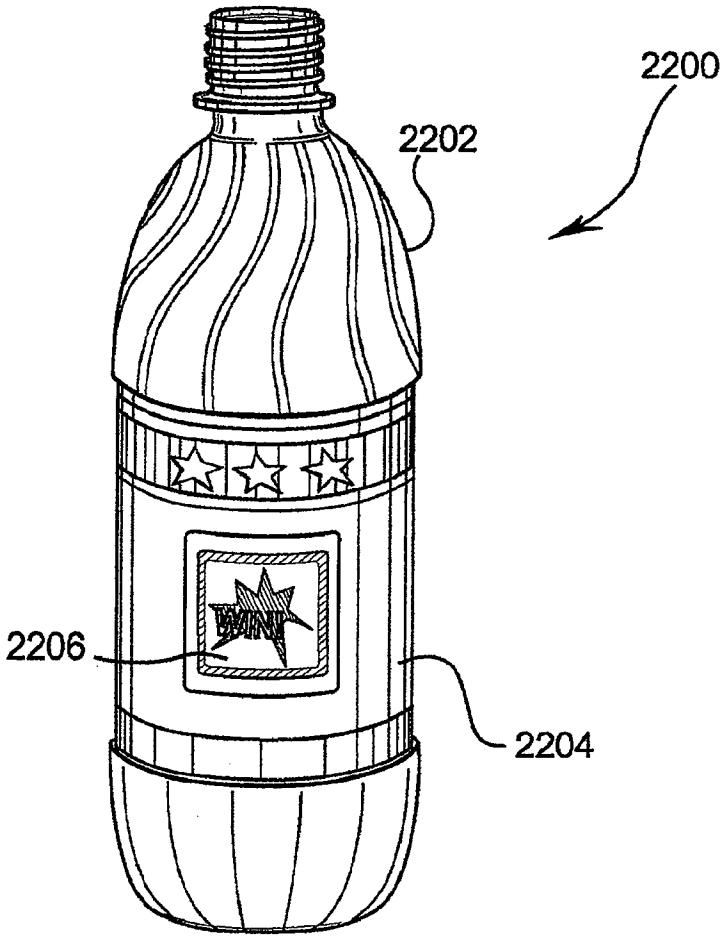
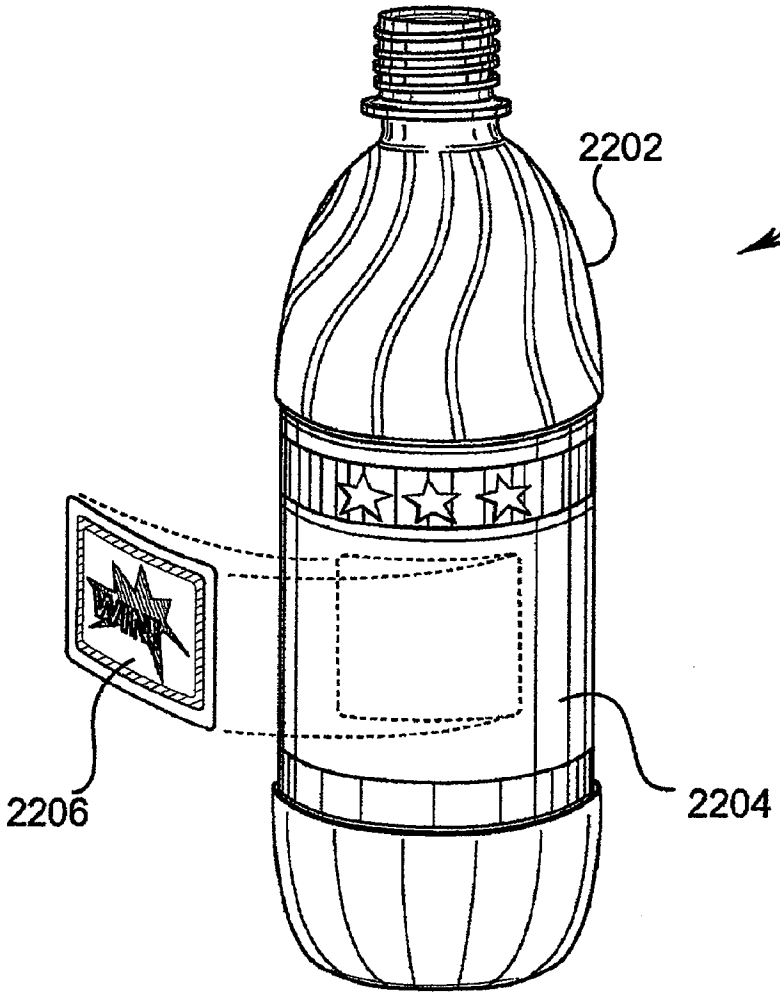


FIGURE 22



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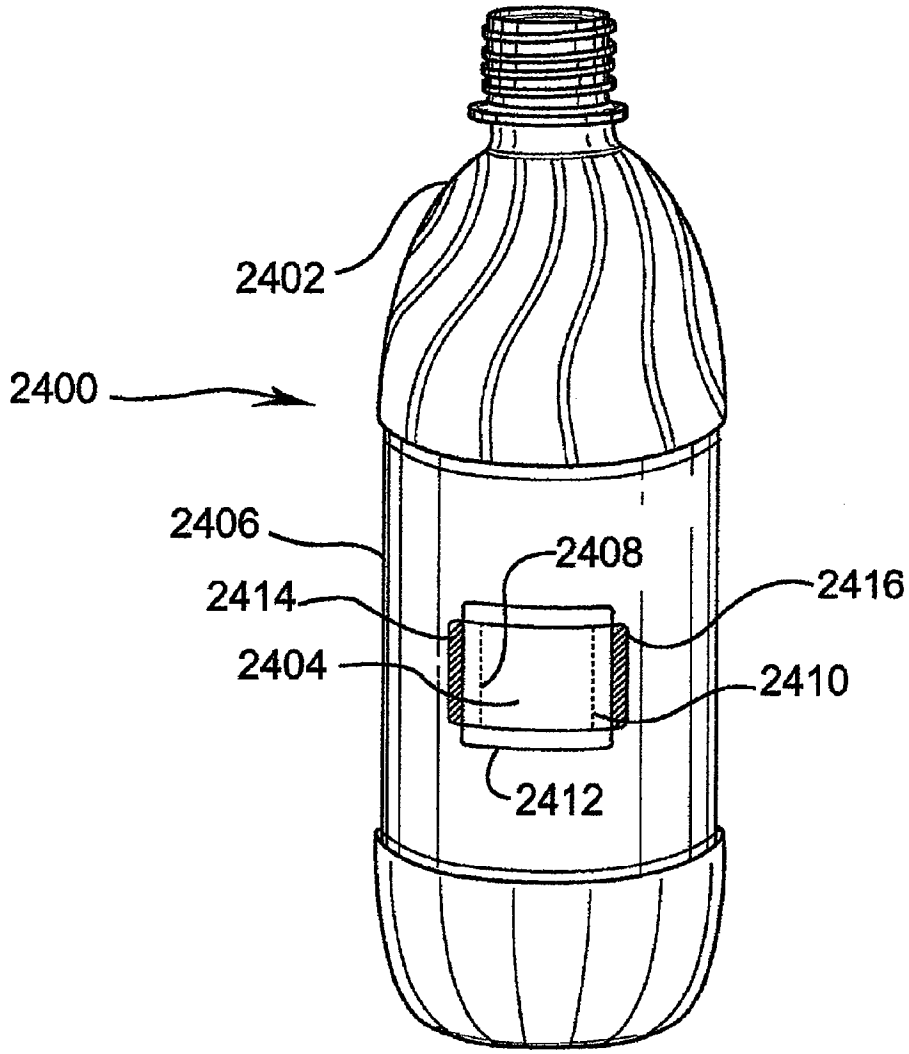

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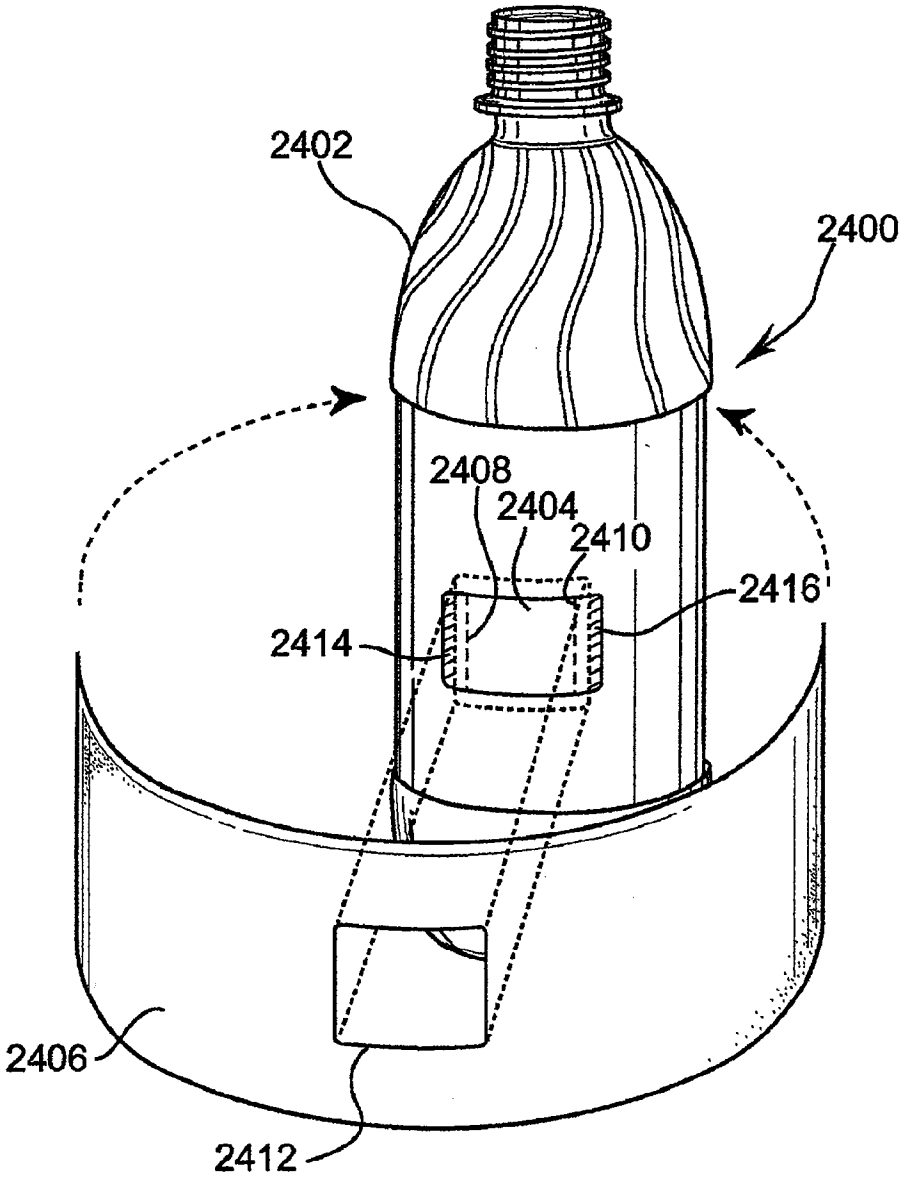

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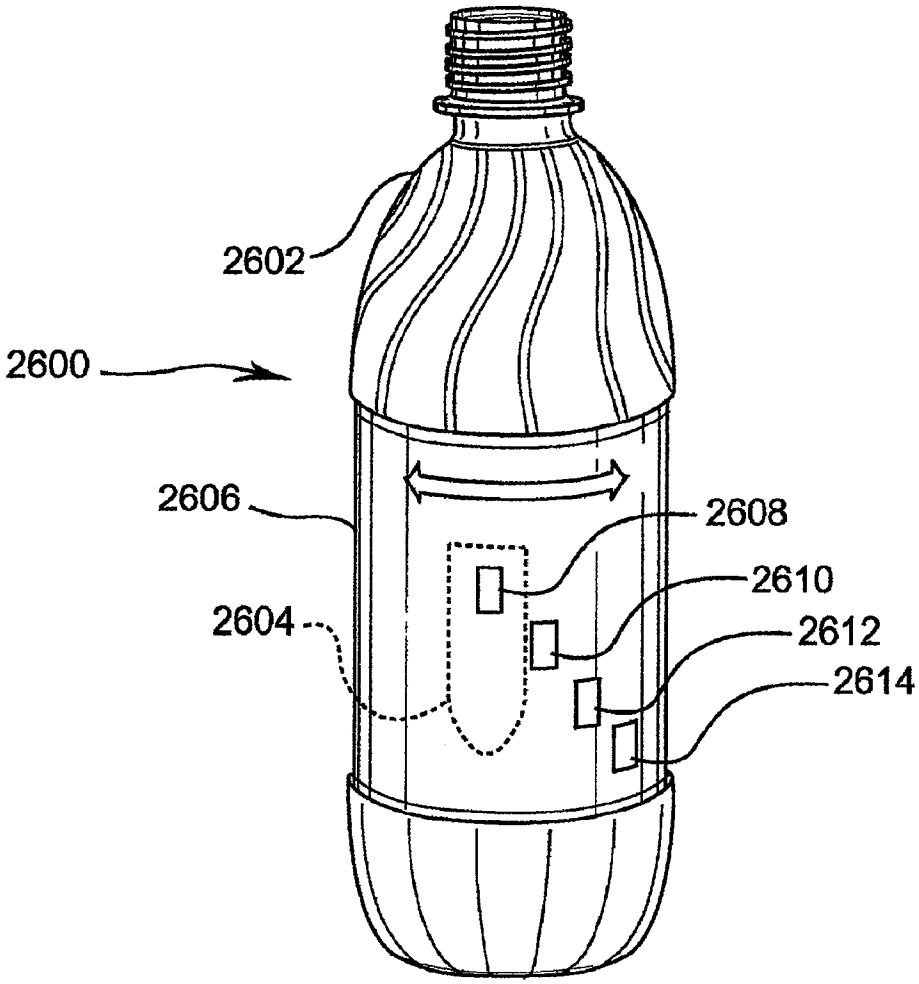

FIGURE 26

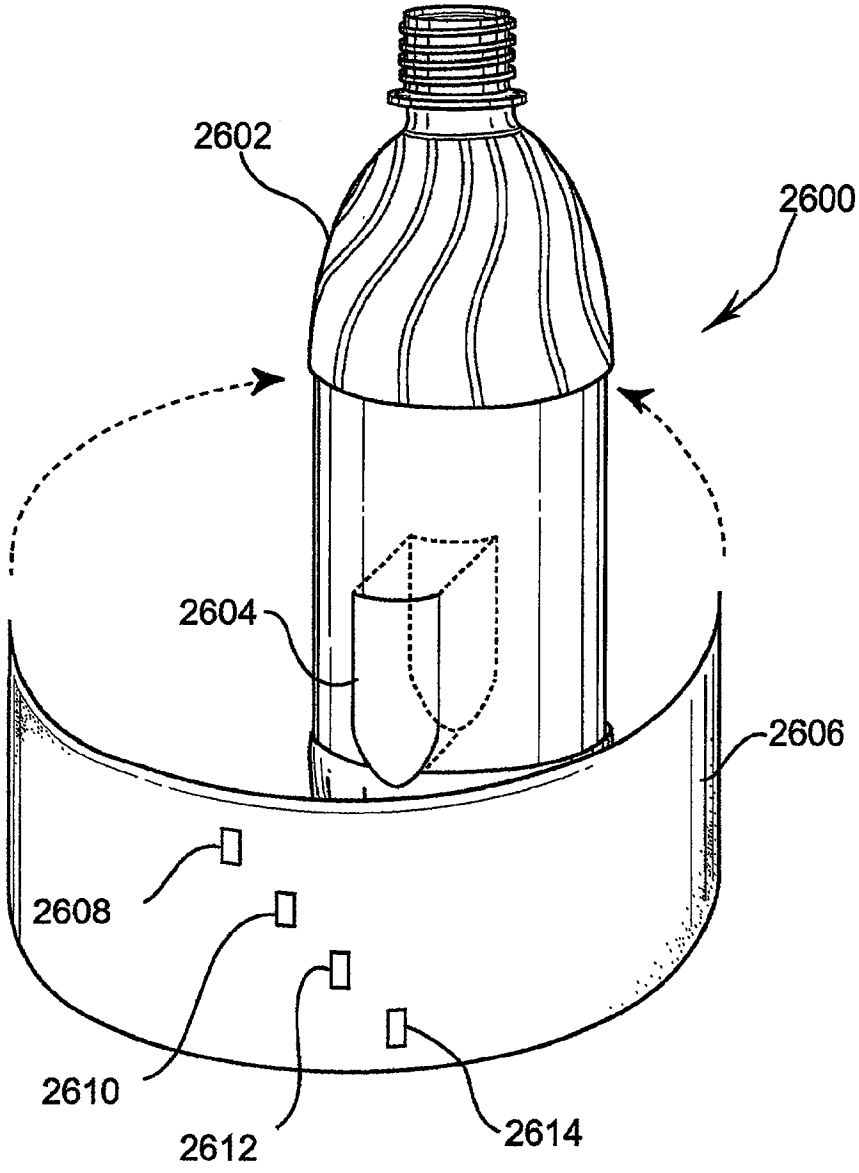

FIGURE 27

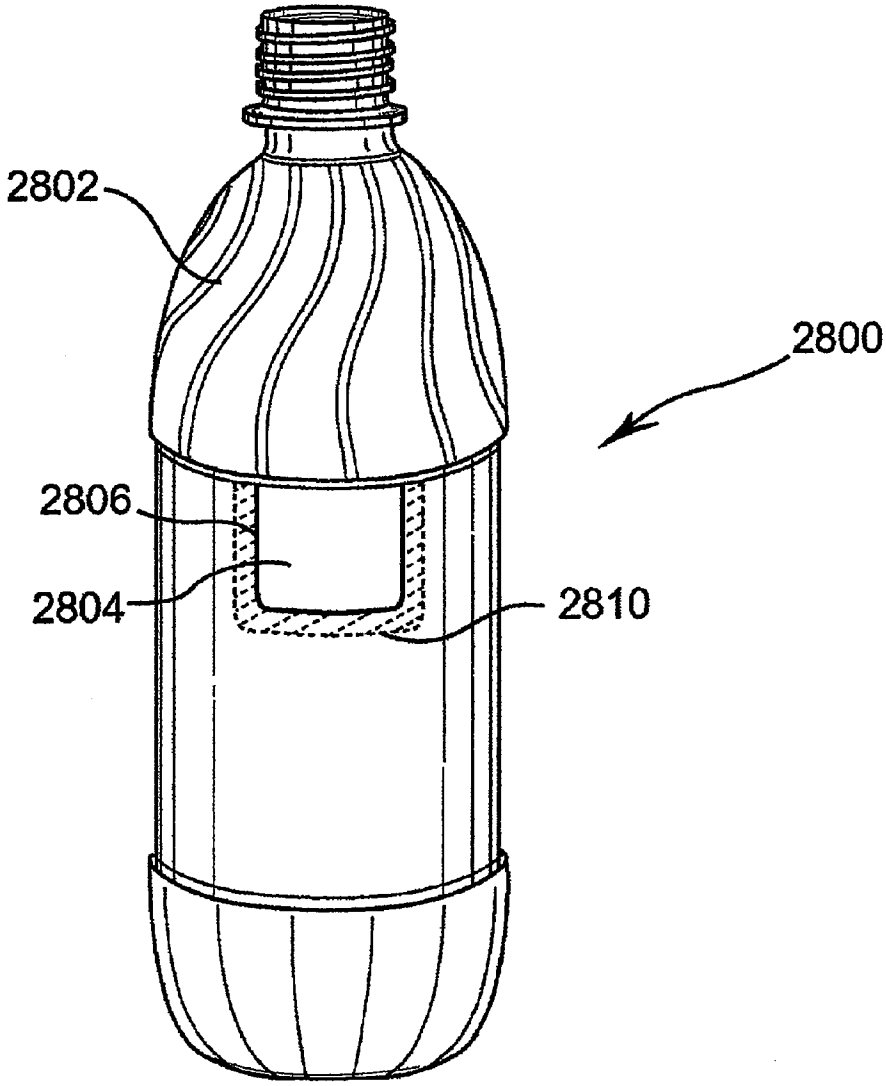

FIGURE 28

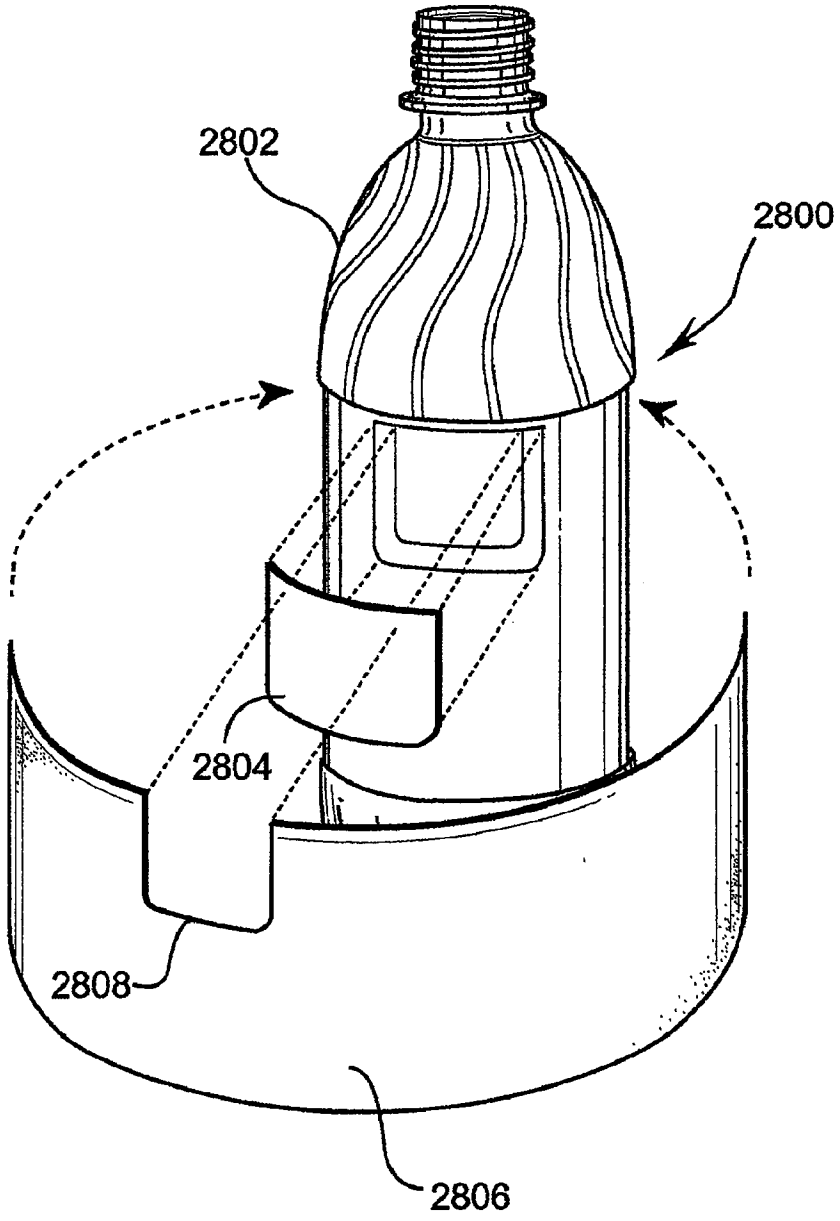

FIGURE 29

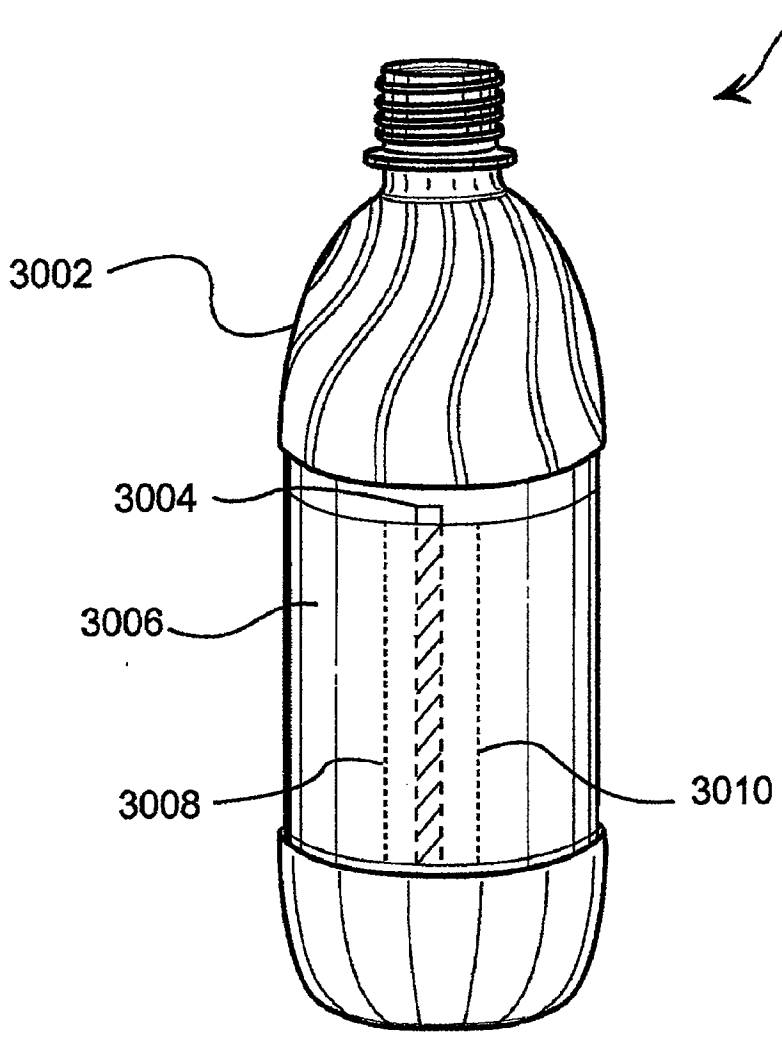

FIGURE 30

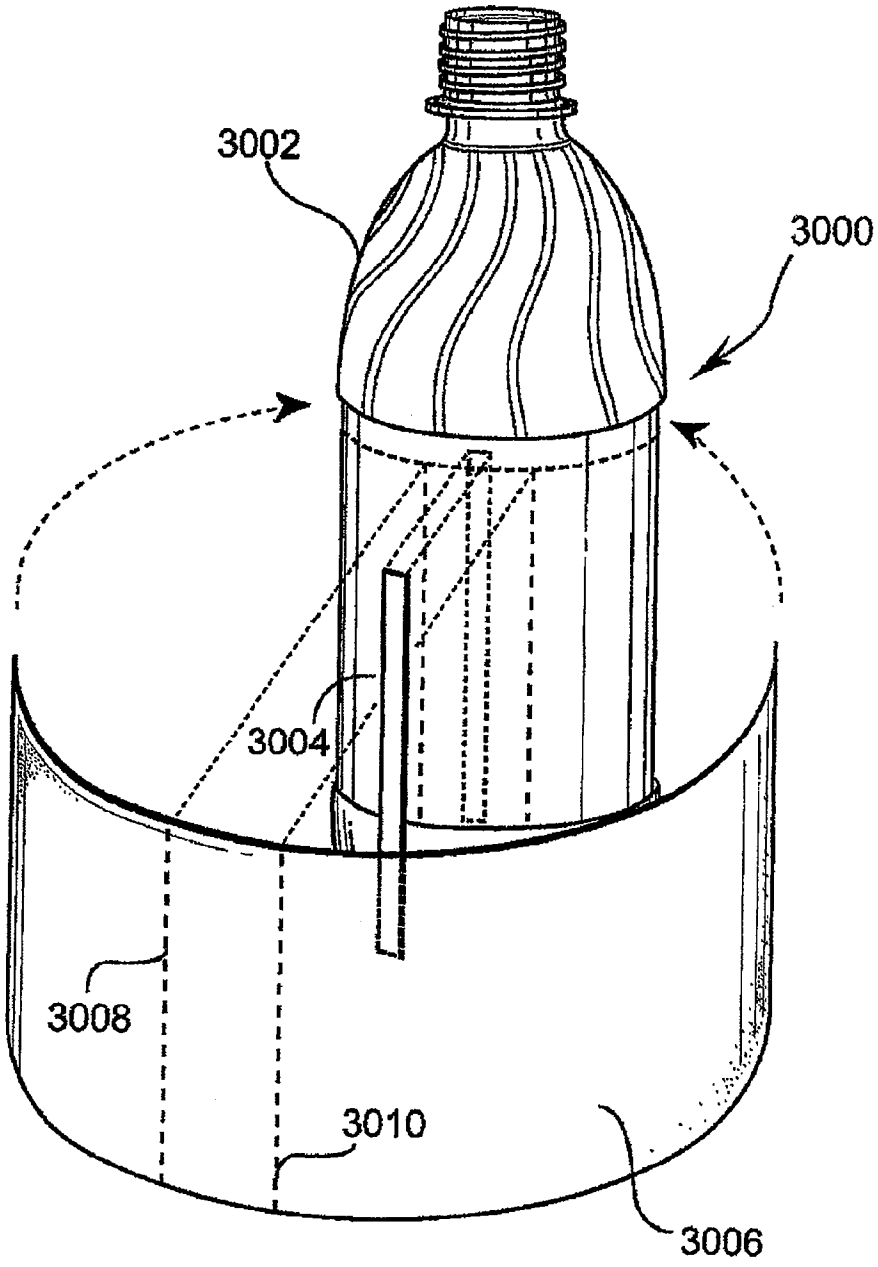

FIGURE 31

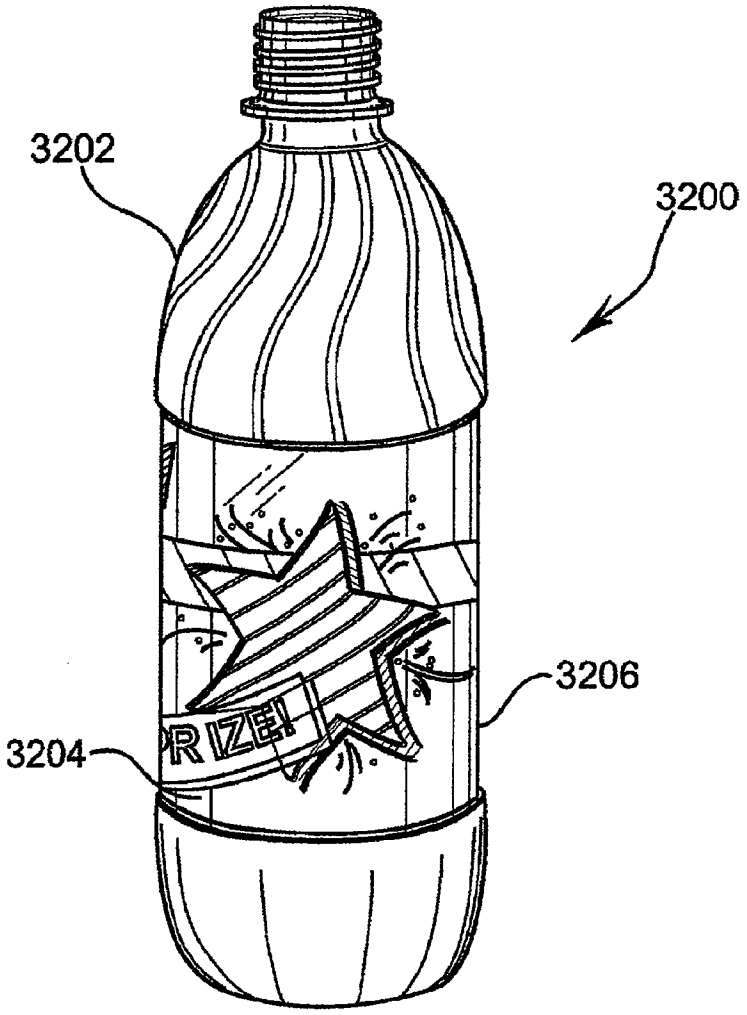

FIGURE 32

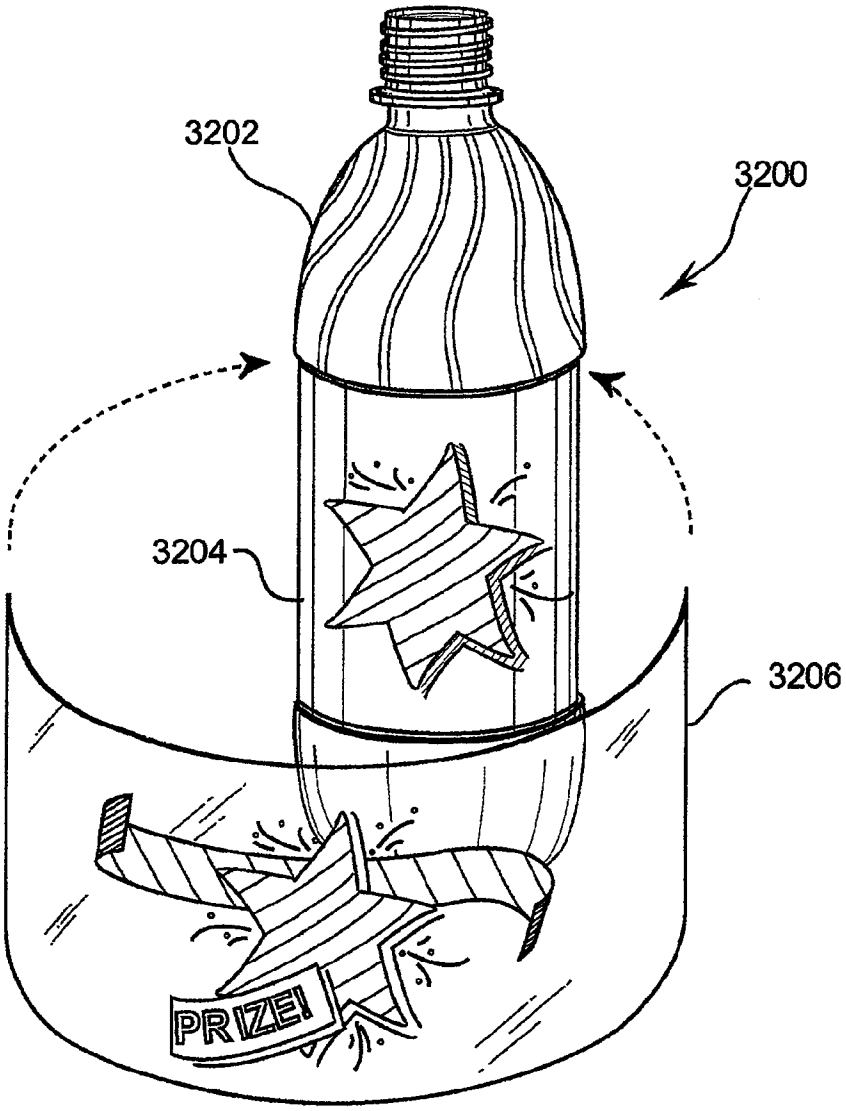

FIGURE 33

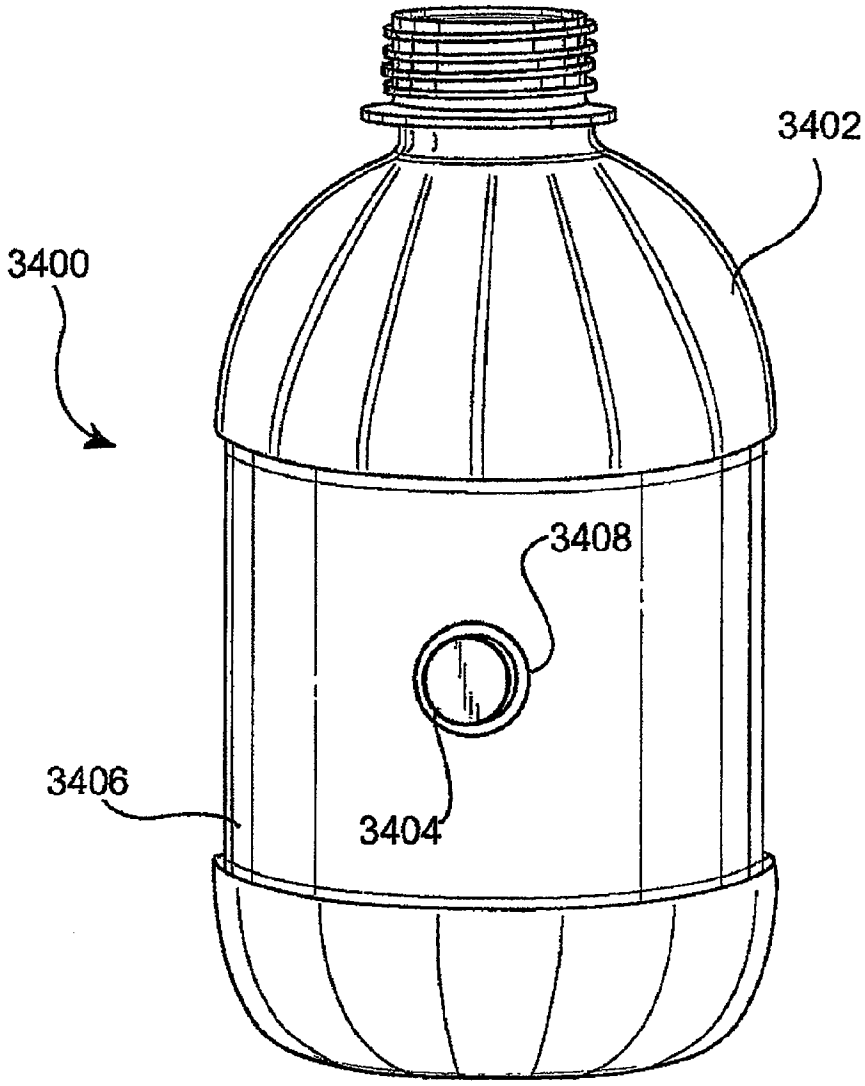

FIGURE 34

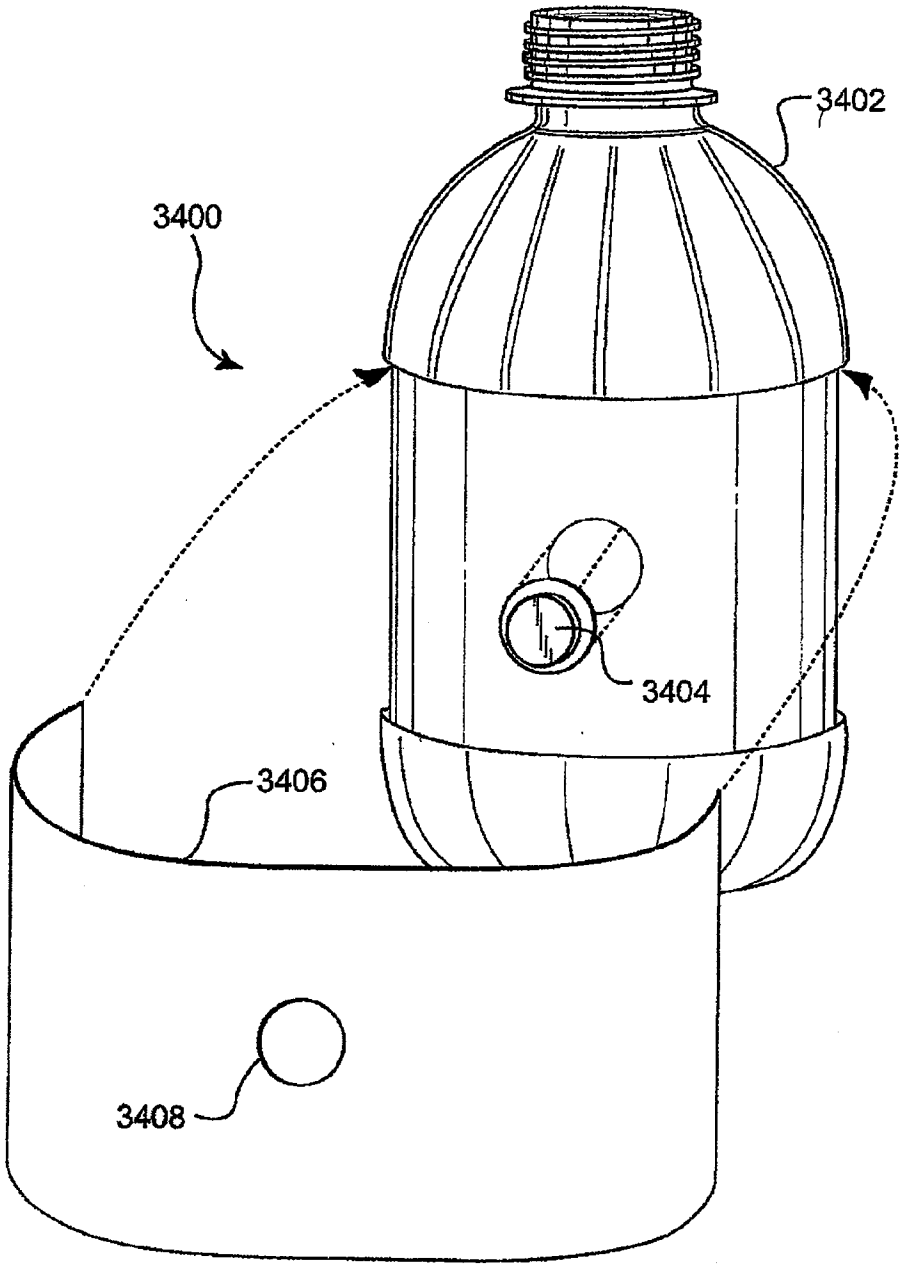

FIGURE 35

MACHINE FOR PLACEMENT OF MULTIPLE LABELS

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application is based upon and claims the benefit of U.S. provisional application No. 60/295,098, entitled "BOTTLE WITH MULTIPLE LABELS", filed Jun. 1, 2001 by Richard Schaupp, Timothy Klein, and John Hickey and U.S. provisional application No. 60/309,679, entitled "MACHINE FOR PLACEMENT OF MULTIPLE LABELS", filed Aug. 2, 2001 by Richard Schaupp, Timothy Klein, and John Hickey, the entire disclosures of both applications are herein specifically incorporated by reference for all that they disclose and teach.

BACKGROUND OF THE INVENTION

[0002] a. Field of the Invention

[0003] The present invention pertains generally to high speed label placement machines and specifically to high speed label placement machines wherein multiple labels are placed on an object.

[0004] b. Description of the Background

[0005] Labels on beverage bottles and the like are critical sales tools for differentiating one product from another. The ability to stand out from the crowd of beverages can make a large difference in the sales of the product and an increase in market share.

[0006] Labels for beverage bottles and the like are applied by different methods. A common method is the roll wrap label wherein a label is presented in the form of a web that is glued at the edges and wrapped around the circumference of the bottle. A second form is a label that is presented on a web carrier and attached with pressure sensitive adhesive. Other forms of labels and methods of application are widely known and practiced.

[0007] It is common from time to time for a beverage manufacturer to have a marketing campaign wherein a premium, game piece, coupon, or other promotional item is to be attached to the packaging in some form. Ideally, the promotional item would be included on the beverage bottle directly. However, the manufacturing complexities have so far limited the promotional items to places such as the bottle cap or applied to a carton or other container in which the bottle comes. It is also common for a manufacturer to place RF identifier tags and bar codes to items at the request of a retailer.

[0008] One of the difficulties is that the game piece or promotional item is likely to be manufactured in a different manner than the exterior label. For example, it may be a multi-folded item made of card stock and the exterior label may be a plastic film. The promotional item may also be attached to the bottle with pressure sensitive adhesive or other mechanism other than the glue strip of the exterior label.

[0009] The difficulty of labeling two dissimilar labels lies primarily in the registration of the two labels with respect to one another. This is due to the fact that one type of label may optimally be manufactured, presented, and applied using one method, such as thin, plastic roll wrapped labels adhered with a strip of glue, and a second type of label may be optimally manufactured, presented, and applied using a second method that is incompatible with the first, such as a cardstock label presented by peeling off of a disposable web backing and applied with pressure sensitive adhesive. In high speed inline labeling machines used in bottling factories, the only option available is a large rotary labeling machine that holds the bottles from the top and bottom during all of the processing done at the machine. These machines are very expensive to buy and operate compared to high-speed in-line machines.

[0010] It would therefore be advantageous to provide a high speed in-line machine for applying a first item to a bottle, such as a pressure sensitive label, maintaining control of the orientation of the bottle while adjusting the orientation to a position to receive a second item of the same or different composition, and applying a second item, such as a roll wrapped label. It would further be advantageous to control the registration of the placement of the items to achieve a variety of functions.

[0011] c. Definitions

[0012] The following definitions are presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the terms to the precise form disclosed, and other modifications and variations may be possible in light of the teachings of this specification.

[0013] Bottle: an object that is processed by a high speed in-line or similar machine, such as a beverage bottle. The bottle may be one of several types containers such as plastic bottles, cups, metal cans, glass wine bottles, tubular cardboard containers, aerosol spray cans, pharmaceutical containers, glass jelly jars, plastic jugs, rotationally molded lidded containers for hardware items like screws and such. Further, the bottle may be any object that is typically sold with labels attached, such as highlighter markers, candles, rolls of paper products, and sundry others. The outside shape of the object does not have to be cylindrical, but can be square, elliptical, or can have other cross-sectional shapes.

[0014] Label: an item that is applied by a high speed in-line or similar machine to a bottle, such as a pressure sensitive label. The label may be a conventional advertising or descriptive label of various constructions, such as paper, cardstock, plastic film, or other label material. The label may be constructed of a single ply of material, or may be a multiple ply construction. Further, the label may be a booklet construction with multiple pages that are glued or bound on an edge. The conventional label may be applied by many different methods, such as pressure sensitive adhesive, hot glue, cold glue, ultraviolet cure glue, dry peel adhesive, heat transfer, or any other type of adhesive. Further, the label may be applied by static charge or other mechanical method so that it stays on the bottle during assembly until a second label captures and contains the first label. Additionally, the label may be a shrink-wrap label that envelops the bottle and is shrunk to the bottle with a heat source. Alternatively the label may actually be a promotional item such as a premium, game piece, coupon, souvenir, phone card, tickets, or the like. Further, the label may comprise a package for holding a liquid or other items, such as a foil packet. Further, the label may be a passive electrical device, such as an RF identifier tag. Further, the label may be an active electronic device, such as a battery operated light or a device for

playing a sound. Alternatively, the promotional item or electrical device may be web converted and presented on a carrier, the carrier being attached directly to the bottle. Further, the label may be a printed mark, logo, set of characters, barcode, or other design that is applied directly by a printing mechanism, such as a sprayed ink printer, transfer printing, pad printing, laser etching, or other printing method. Further, the label may be a brand identifier, logo, or special advertising item. For example, the label may be a holographic image, diffraction grating, reflective media, or other special material. A label may also be a device for tearing or removing a second label. These examples are not meant to limit the types of labels and of course, those skilled in the arts of promotional items, labels, and the general packaging industry would be able to expand these examples and still fall within the scope of this invention.

[0015] Game piece: an item specifically adapted for a promotional game. The typical game piece may be of several varieties. These include instant win game pieces where a consumer can redeem the game piece for a prize instantly, may be a collection type game where two or more game pieces must be collected and redeemed together, or other type of game where the consumer compares the game piece code to a code on a website or other advertisement. The game piece typically involves a variable printing process whereby the text or image on the game piece can be varied during the printing process. The game piece may be a simple printed mark on the bottle comprising text, graphics, barcode, or other images. The game piece may be a multipart label where the consumer must peel apart one layer of the label to expose the variable printed image. These examples are not meant to limit the types of game pieces and of course, those skilled in the arts of promotional items, labels, and the general packaging industry would be able to expand these examples and still fall within the scope of this invention.

SUMMARY OF THE INVENTION

[0016] The present invention overcomes the disadvantages and limitations of the prior art by providing a high speed in-line machine to assemble labels on a bottle. The machine can be used to apply two dissimilar labels to a bottle wherein each label is applied by a different mechanism. The dissimilar labels may be placed and registered with respect to one another on the bottle. The combinations may be used to create advertising devices and product packaging devices that were heretofore impractical to produce.

[0017] One embodiment of the present invention pertains to a high speed in-line bottle labeling machine, wherein bottles travel through the machine in a cradle that allows the bottle to rotate. A first label is presented and applied to the bottle under positive control as it passes through the machine. A positioning mechanism rotates the bottle a controlled amount in the cradle to a second orientation. A second label is presented and applied to the bottle as it continues through the machine and then exits the machine. The registration of the two labels is controlled with the repositioning devices.

[0018] The first label to be applied can be of any desired construction and attached to the bottle by any desired method. For example, the label may comprise a preprinted, adhesive backed label, an RF identifier tag on a pressure sensitive backing, a promotional game piece applied with glue, a package of liquid additive for the contents of the bottle applied with hot glue, or a barcode image printed directly on the bottle, etc. Of course, this list is merely an example of the diverse set of articles that may be placed, printed, adhered, applied or otherwise assembled to the surface of the bottle.

[0019] The cradle mechanism is constructed to support the bottle and allow the bottle to rotate while it is presented to the first label station, the positioning device, and the second label station.

[0020] The positioning mechanism can be a single powered roller, a continuously moving, constant speed belt, a belt that can be adjusted in speed and direction during the turning process, a stationary frictional surface, or other mechanism or combination of mechanisms to change the orientation of the bottle while it is in the cradle. Further, the positioning mechanism may be incorporated into a processing station, such as a label applicator, or the positioning mechanism may be a separate entity that is not attached to one or more processing stations.

[0021] The second label to be applied can be of any desired construction and attached to the bottle by various methods. For example, the second label may be a roll wrapped plastic film label or other type of label. Of course, the example is meant only for illustrative purposes.

[0022] The invention also includes the advertising and packaging devices heretofore unproducible on conventional packaging equipment. Several variations of multiple labels that are used in accordance with the present invention require registration of the labels with respect to each other that is the result of positive control of the bottle during labeling.

[0023] For example, a first label, such as a promotional game piece, may be placed on a bottle and have a second label placed over the first. The second label must be registered to the first so that the glue used to assemble the second label to the bottle does not overlap the first label. In this embodiment, the consumer can remove the second label to gain access to the first in order to play the game.

[0024] In a second example, a first label such as a game piece, may be placed onto a bottle and a second label may be placed over the first label with a window through the second label so that the first label is visible. The second label must be registered to the first label so that the window is properly located and the first label is therefore visible.

[0025] A third example may be the placement of a first label, such as a game piece on a bottle. A second label having a window may then be placed over the first label, such that the first label is visible through the window. One or more edges of the first label may be viewable through the window. In this example, perforations may be added to the first or second labels to assist the consumer in removing the promotional item. Further, an exposed edge of the first label may not have adhesive applied near the edge so that the consumer may use a fingernail to further assist in removing of the first label. The second label must be registered to the first label so that the window shows the appropriate section of the first label.

[0026] A fourth example may be a bottle that may be labeled first with a booklet attached with pressure sensitive

adhesive and covers a portion of the circumference. A second label may be a roll wrapped plastic film label and attached to or near one end of the first label and continue around the remainder of the circumference to end on or near the opposite end of the first label. Registration of the second label to the first is important so that the overlap of the two labels does not interfere with the use and function of the booklet.

[0027] A fifth example is a bottle wherein an adhesive backed RF tag may be placed on a bottle and a second label is roll wrapped around the complete exterior of the bottle, covering the RF tag so that it is not unsightly. Instead of an RF tag, a promotional item, such as a ticket or coupon may be placed underneath the second label. The registration of the RF tag to the roll wrapped label is important since the RF tag may interfere with the gluing of a roll wrapped label if improperly registered.

[0028] A sixth example is a bottle with a roll wrapped label applied with glue with the label covering the circumference of the bottle and a second label which is a promotional item adhered with pressure sensitive adhesive to a specific location to the outside of the first label. In this case, the second label may be a decorative item manufactured of a different method than the first, such as a holographic image or diffraction grating. The second label should be registered to the first so that the promotional item occupies a designated space on the first label.

[0029] A seventh example is a bottle with a first label, such as a removable game piece, viewable through a window in the second label. In this case, the first label has two edges that are exposed through the window and perforations or scoring along the edges that are not exposed. This combination allows the consumer to remove the first label without damaging the second label. The second label must be registered to the first label so that the perforated lines are positioned properly to aid the consumer in removing the game piece.

[0030] An eighth example is a bottle with a first label and a second label that is moveable over the first. The second label may be a roll wrapped label wherein the label is glued only to itself and not the bottle, so that the second label may be twisted on the bottle. One or more windows in the second label can then be moved over the first label, creating a game for the consumer to play. The second label must be registered with respect to the first label to avoid any assembly problems with the roll wrapped label assembly.

[0031] A ninth example is a bottle with a first label that is entrapped on three sides by a second label. The second label has a window or cut out whereby three edges of the first label are covered and the forth edge of the first label is exposed. Registration between the first label and second label must be sufficient so that the first label does not interfere with the assembly process of the second label.

[0032] A tenth example is a bottle with an outside label and a tab label, string, or other device that aids in the removal of the label. The outside label may have perforations, scoring or other devices to aid in the tearing of the label. The device to aid removal may have a tab that is exposed for the consumer to grip as the consumer removes the outer label. The outside label must be registered to the tab label for the tearing action of the tab label to be effective.

[0033] An eleventh example is a bottle with a first label that is opaque and a second label that is printed on a transparent media. The first label may be a standard product label and the second label may be a special promotional label. The second label is selectively transparent so that portions of the first label are visible through the second. The second label must be registered to the first label so that the proper visual effect of the two labels is achieved.

[0034] A twelfth example is a bottle with a first item that is applied and an overlapping label with a window through which protrudes a portion of the first item. The first item may be a container for something or it may be decorative item only. The container may be used for promotional items such as a premium, or it may be used for a complementary product or accessory to the item sold in the container, such as a package of mounting screws for a container of a hardware product. The overlapping label, and its window must be registered with respect to the first item so that the first item fits through the window properly, otherwise the overlapping label will not assemble correctly.

[0035] The above examples are not exhaustive of the combinations of items to be placed on a bottle where the registration of the items is important. As one skilled in the art would appreciate, the present invention would apply to bottles, cans, and other containers or objects especially cylindrical containers and objects to which labels and other articles are applied.

[0036] The present invention may therefore comprise a method of applying at least two labels to a substantially cylindrical object with a predetermined angular orientation of the labels about the axis of the cylinder on an in-line labeling machine comprising: placing the object into a cradle, the cradle allowing the object to freely rotate about the axis, the cradle being mounted to a star wheel comprising a plurality of the cradles; passing the object past a first labeling machine, the first labeling machine being capable of presenting a first label and applying the first label to the object by rotating the object in the cradle; positioning the object with a turning mechanism, the turning mechanism having a mechanism that engages the object on the cylindrical surface and changes the rotational orientation of the object to a predetermined orientation; and presenting the object to a second labeling machine, the second labeling machine being capable of presenting a second label and applying the second label to the object, the second label being in a predetermined angular orientation with respect to the first label.

[0037] The present invention may further comprise an in-line machine for applying at least two labels to a substantially cylindrical object with a predetermined angular orientation of the labels about the axis of the cylinder comprising: a star wheel, the star wheel comprising a plurality of cradles, the cradles allowing the object to freely rotate about the axis; a first labeling machine, the labeling machine being capable of presenting a first label and applying the first label to the object by rotating the object in the cradle; a turning mechanism, the turning mechanism having a mechanism that engages the object and changes the rotational orientation of the object to a predetermined orientation; and a second labeling machine, the labeling machine being capable of presenting a second label and

applying the second label to the object, the second label being in a predetermined angular orientation with respect to the first label.

[0038] The present invention may further comprise an object with multiple labels comprising: an object being substantially cylindrical and having a major axis; a first label; and a second label, the second label being placed over at least a portion of the first label, the position of the second label being angularly oriented about the major axis of the object with respect to the first label, wherein the first label and the second label are adhered to the object by different mechanisms.

[0039] The present invention may further comprise a substantially cylindrical object with at least two labels manufactured on an in-line labeling machine using a process comprising: placing the object into a cradle, the cradle allowing the object to freely rotate about the axis, the cradle being mounted to a star wheel comprising a plurality of the cradles; passing the object past a first labeling machine, the first labeling machine being capable of presenting a first label and applying the first label to the object by rotating the object in the cradle; positioning the object with a turning mechanism, the turning mechanism having a mechanism that engages the object on the cylindrical surface and changes the rotational orientation of the object to a predetermined orientation; and presenting the object to a second labeling machine, the second labeling machine being capable of presenting a second label and applying the second label to the object, the second label being in a predetermined angular orientation with respect to the first label.

[0040] The advantages of the present invention are that a plethora of options for the label designer and marketing professional to create product differentiation for their specific application. Further, the ability to accurately place multiple labels of different constructions allows the marketing professional many options for displaying product information, for hiding unsightly RF tags, for developing promotions, and for other options within their purvey. Also, since the labels can be applied at high speed, the manufacturing of these products can be done in a cost efficient manner.

BRIEF DESCRIPTION OF THE DRAWINGS

[0041] In the drawings,

[0042] **FIG. 1** is a top view of a high speed bottle labeling machine showing a first label being attached with pressure sensitive adhesive and a second label being a roll wrapped label applied with hot glue and a positioning mechanism comprising a moving belt.

[0043] **FIG. 2** is a detail view of a section of **FIG. 2** showing the first label being applied.

[0044] **FIG. 3** is view similar to **FIG. 2**, but showing the bottle at the point where the first label has just been applied, and a second bottle ready for the second label application.

[0045] **FIG. 4** is a perspective view of the embodiment of **FIG. 1**.

[0046] **FIG. 5** is a perspective view of a detail of the embodiment of **FIG. 4**, shown from the opposite side of the machine from **FIG. 4**.

[0047] **FIG. 6** is a perspective view of a detail of the embodiment of **FIG. 5**.

[0048] **FIG. 7** is a perspective view of the cradle of the embodiment of **FIG. 4**.

[0049] **FIG. 8** is a top view of a high speed bottle labeling machine showing a first label being attached with pressure sensitive adhesive and a second label being a roll wrapped label applied with hot glue and a position mechanism comprising an applicator wheel and a friction fence.

[0050] **FIG. 9** is a detail view of a section of **FIG. 8** showing the first label ready to be applied and the second label ready to be applied.

[0051] **FIG. 10** is view similar to **FIG. 9**, but showing the bottle at the point where the first label is being applied and the bottle is being repositioned.

[0052] **FIG. 11** is a view similar to **FIG. 9**, but showing the bottle being repositioned.

[0053] **FIG. 12** is a detail view of a section of another embodiment of the invention showing an alternative method for delivering the first label and repositioning the bottle.

[0054] **FIG. 13** is an illustration of an embodiment of the inventive label configuration wherein a first label is hidden by a second label.

[0055] **FIG. 14** is a perspective view of **FIG. 13** shown in the exploded state.

[0056] **FIG. 15** is a perspective view of another embodiment of the inventive label configuration of the present invention having a first label and a second label with a window aligned with the first wherein one or more edges of the first label are exposed through the window.

[0057] **FIG. 16** is a perspective view of **FIG. 15** shown in the exploded state.

[0058] **FIG. 17** is perspective view of an embodiment of the inventive label configuration of the present invention having a portion of a first label appear through a window in a second label.

[0059] **FIG. 18** is a perspective view of **FIG. 17** shown in the exploded state. **FIG. 19** is a perspective view of another embodiment of the inventive label configuration of the present invention having a first label and a second label wherein the second label attaches to one end of the first label and wraps around to attach to the opposite end of the first label.

[0060] **FIG. 20** is a perspective view of **FIG. 19** shown in the exploded state.

[0061] **FIG. 21** is a top view of the embodiment of **FIG. 19** shown with each element slightly exploded.

[0062] **FIG. 22** is a perspective view of an embodiment of the inventive label configuration of the present invention having a first label and a second label wherein the second label is attached to the outside of the first label.

[0063] **FIG. 23** is a perspective view of **FIG. 22** shown in the exploded state.

[0064] **FIG. 24** is a perspective view of an embodiment of the inventive label configuration of the present invention

wherein a first label is viewable through a window in a second label and two edges of the first label are exposed through the window.

[0065] **FIG. 25** is a perspective view of **FIG. 24** shown in the exploded state.

[0066] **FIG. 26** is a perspective view of an embodiment of the inventive label configuration of the present invention having a first label and a second label wherein the second label is assembled so that it can be twisted about the bottle.

[0067] **FIG. 27** is a perspective view of **FIG. 26** shown in the exploded state.

[0068] **FIG. 28** is a perspective view of an embodiment of the inventive label configuration of the present invention having a first label and a second label wherein the first label is exposed through a window in the second label wherein the window is comprised of a notch in the second label.

[0069] **FIG. 29** is a perspective view of **FIG. 28** shown in the exploded state.

[0070] **FIG. 30** is a perspective view of an embodiment of the inventive label configuration of the present invention having a label and a device to aid in removing the label.

[0071] **FIG. 31** is a perspective view of **FIG. 30** shown in the exploded state.

[0072] **FIG. 32** is a perspective view of an embodiment of the inventive label configuration of the present invention comprising a first label and a second label wherein the second label is a semi-transparent label that covers the first label.

[0073] **FIG. 33** is a perspective view of **FIG. 32** shown in the exploded state.

[0074] **FIG. 34** is a perspective view of an embodiment of the inventive label configuration of the present invention having a first item and a second label wherein the first item protrudes through a window in the second label.

[0075] **FIG. 35** is a perspective view of **FIG. 34** shown in the exploded state.

DETAILED DESCRIPTION OF THE INVENTION

[0076] **FIG. 1** illustrates an overall view of an embodiment of the inventive machine wherein the positioning device is a moving belt. The bottles move from right to left through the machine. The bottles enter the machine on conveyor **102** and inlet screw **104** separates bottles to be fed into the machine **100**. Bottle **106** is shown in the inlet screw **104**, and bottle **108** is shown traveling on the conveyor **102** properly separated from bottle **110**. The inlet star wheel **112** takes each bottle in turn and nestles it into cradle **128** in the main star wheel **116**. Bottle **110** is shown just prior to being nestled into cradle **128**. The main star wheel **116** is rotated in a counter clockwise direction, moving the bottles past first label station **118**, a positioning device **120**, and a second label station **122**.

[0077] The first label station **118** is a conventional label dispenser for a pressure sensitive adhesive backed label. These types of label applicators transport the labels on a web that is passed over a peel point **124** wherein the web is forced to turn on a very small radius, causing the labels to peel from the web. The web is advanced by a pinch roller mechanism **126** when one label is removed and another one required.

[0078] The positioning device **120** is a powered belt that causes a bottle in a cradle to rotate as it passes past the positioning device **120**. In this embodiment, the positioning device **120** is incorporated in first label station **118**.

[0079] The second label station **122** is a conventional roll wrapped label applicator. These types of label applicators have the labels presented in the form of a web, which is cut and placed on a vacuum drum **132**. A strip of glue is then applied to each end of the labels by the glue dispensing mechanism **130**. The leading edge of the label is applied to the bottle, and the bottle is rolled against a friction pad until the glued trailing edge of the label is adhered to the bottle.

[0080] Those skilled in the art can readily appreciate the various combinations of a first processing station, a registration mechanism, and a second processing station of which the machine **100** is a single embodiment. Alternative embodiments may include any combination of two different or the same label applicators, such as a roll wrapped applicators, applicators for web converted products such as the nip roller style or tamp and blow style, pick and place style applicators, applicators for liner-less labels, burst and place applicators for items separated by perforations or scoring, static charged applicators for adhesive-less application of labels, applicators for labels with ultraviolet cured adhesive, and any other label applicator. Additional embodiments may have one or both processing stations comprise a printing or etching station, such as a laser etching station for etching an image, barcode, or text onto a plastic bottle, a pad printing station, a heat transfer printing machine, an ink jet type printing device, or other direct printing type of station. Further, another embodiment may be the first processing station comprising a glue dispensing station and the second processing station comprising a label applicator that places the label onto the glue.

[0081] Although the number of objects attached to a bottle in the embodiment of **FIG. 1** is shown as two objects, any number of objects (within reason) can be placed on the bottle. The example of two labels is given only for exemplary purposes and it can be fully appreciated by persons skilled in the art that the same principles and concepts of the invention do encompass designs wherein the number of processing stations can be greater than two.

[0082] **FIG. 2** illustrates a detail view of the embodiment of **FIG. 1**, showing the application of a first label **202** to bottle **204** and a second label **206** to bottle **208**. As the bottle **204** advances towards the belt **210**, first label **202** is pinched between the bottle **204** and the belt **210**. At this point, known as the nip point, the belt's clockwise rotation pulls the remainder of the first label **202** off of the web **212** and presses the first label **202** onto the bottle **204**. As bottle **208** advances toward vacuum drum **132**, second label **206** is applied to bottle **208**. The rotation of vacuum drum **132** in a clockwise direction forces bottle **208** against a frictional fence **214**, which rolls the label **206** onto the bottle **208**. It is not necessary for the proper function of the machine that the two labels be applied simultaneously.

[0083] **FIG. 3** illustrates a detail view of the embodiment of **FIG. 1**, and similar to **FIG. 2** except that the main star wheel **116** has advanced to the point where the bottle **204** is

being positioned by the belt **210**. At this point, the belt **210** is spinning the bottle **204** in a counter clockwise direction. Bottle **208** is also being spun in a counter clockwise direction by virtue of the clockwise rotation of vacuum drum **132** pressing bottle **208** against frictional fence **214**. Second label **206** is almost fully attached to the bottle **208**.

[0084] The construction of belt **210** may be a timing belt with teeth, or may comprise an o-ring or other belting medium. The belt **210** is such that it frictionally grabs the bottle **204** and causes it to spin. The belt **210** may further comprise an upper and lower belt such that the upper and lower belts touch the bottle in certain areas and avoid touching the bottle in other areas. Such a configuration may be required if, for example, the first processing station applied an area of glue and it was desired that the belt **210** not touch the glue during positioning.

[0085] The gear ratio of the belt **210** to the main star wheel **116** is selected so that the first label **202** is fully applied to the bottle **204** and positions the bottle **204** in the cradle to accept the second label. The gear ratio of belt **210** to main star wheel **116** may be further increased or decreased to adjust the position of the bottle **204** in the cradle. In this manner, the registration of the first label **202** to the second label is adjusted during machine set up and operation. As the speed of the machine increases, the effects of inertia when the bottle is spinning, friction in the cradles, and other elements combine to shift the registration of the first and second labels. By adjusting the gear ratio between the belt **210** and the main star wheel **116** as the speed increases, an operator or set up technician can adjust the registration of the two labels. It is common for the belt **210** to be controlled with a servo motor which is electronically geared to an input, such as an encoder on the main star wheel **116**. Being electronically geared the effective gear ratio to change with different parameters, including speed of the main star wheel **116**.

[0086] An alternative method to a constant gear ratio belt **210** is to change the speed of the belt **210** during the period that it is engaged with the bottle **204**. For example, the belt **210** may begin so that the surface speed of the belt **210** is the same as the surface speed of the bottle **204** as it touches the nip point. After the label **202** is nipped between the belt **210** and the bottle **204**, the belt **210** may be increased in speed to apply the label and position the bottle **204**, and then it may be slowed down to the same speed as at the nip point. This speed profile leaves the bottle **204** in a state where it is not rotating in the cradle, which tends to minimize the inaccuracy of the registration of the first label to the second.

[0087] Further, an alternative embodiment of the positioning mechanism **210** may comprise a series of belts that rotate the bottle at different speeds or speed profiles during the passage of the bottle through the machine. For example, a first belt may apply a first label at a certain preset speed that is geared to the speed of the main star wheel **116**. A second belt may have a variable speed profile that positions the bottle in the cradle.

[0088] A feedback system may be employed in the positioning mechanism to sense the label position and dynamically adjust the exact position of the bottle in the cradle to accept a second label. The feedback system may be attached to any of the embodiments of the positioning mechanism.

[0089] **FIG. 4** shows a perspective view of the embodiment shown in **FIG. 1**. In this view, the bottles move from left to right through the machine. A bottle **402** is shown being separated by inlet screw **404**. A second bottle **406** is shown just prior to being placed in cradle **408** in main star wheel **410** by inlet star wheel **412**. Main star wheel **410** turns in a counter clockwise direction in this view. A portion of the first label feeder mechanism **414** is visible. The bottle **416** is in the positioning station where the first label is fed and the bottle repositioned for the second label. The bottle **416** is guided at the top by guide rail **418**.

[0090] **FIG. 5** shows a detail perspective view of the machine of **FIG. 4**, showing the positioning belt **502** from the opposite side of the machine as the view of **FIG. 4**. In this view, the main star wheel **410** moves in a counter clockwise direction and the bottles progress from right to left. Bottle **416** is shown in cradle **504** being turned by belt **502**. Belt **502** is driven by servo motor **506** shown partially cut away. The servo motor **506** is being driven in a counter clockwise direction. First label **508** is shown attached to the bottle **416** as the bottle **416** is being rotated to a specific position prior to receiving a second label. Vacuum drum **510** turns in a clockwise direction and places the second label on the bottle.

[0091] **FIG. 6** shows a wider detail perspective view of the machine of **FIGS. 4 and 5**, taken from the same side of the machine as **FIG. 5**. In this view, the bottles progress from right to left and main star wheel **410** moves in a counter clockwise direction. Bottle **416** is shown in main star wheel **410** along with motor **506** and guide **418**. Bottle **602** is in the process of receiving second label **604** from vacuum drum **510**. As the bottles begin the process of receiving the second label, they are forced to roll against friction surface **606** that simultaneously removes the bottles from their cradles in main star wheel **410**.

[0092] **FIG. 7** shows a close up view of a typical cradle in a main star wheel of a typical embodiment of the invention. The cradle comprises several wheels **702** in a semicircular shape. The bottles rest against the wheels **702** without being marred or damaged. The wheels **702** are mounted on axles **704** which are pressed through plate **706**. The wheels **702** are further mounted on bearings that are not seen in this view.

[0093] **FIG. 8** shows a top view of another embodiment of a high speed bottle labeling machine **800**. The bottles progress through the machine from right to left in this view. The bottles enter the machine on conveyor **802** as inlet screw **804** separates bottles to be fed into the machine **800**. Bottle **806** is shown in the inlet screw **804**, and bottle **808** is shown traveling on the conveyor **802** properly separated from bottle **810**. The inlet star wheel **812** takes each bottle in turn and nestles it into a cradle in the main star wheel **814**. Bottle **810** is shown just prior to being nestled into cradle **816**. Bottle **830** is shown in contact with nip roller **832**.

[0094] The main star wheel **814** is rotated in a counter clockwise direction, moving the bottles past first label station **818**, an optional fixed positioning device **820**, and a second label station **822**.

[0095] The first label station **818** is a conventional label dispenser for a pressure sensitive adhesive backed label. These types of label applicators transport the labels on a web that is passed over a peel point **824** wherein the web is forced to turn on a very small radius, causing the labels to peel from the web. The web is advanced by a pinch roller mechanism **826** when one label is removed and another one required.

[0096] The optional fixed positioning device **820** may be a frictional pad that causes a bottle in a cradle to rotate as the bottle passes over the device **820**. The purpose of the positioning device is to turn the bottle a certain amount between the first label station **818** and the second label station **822**. In this manner, the registration of a label applied by the first label station **818** is maintained with a second label applied by second label station **822**.

[0097] The second label station **822** is a conventional roll wrapped label applicator. These types of label applicators have the labels presented in the form of a web, which is cut and placed on a vacuum drum **828**. A strip of glue is then applied to each end of the labels. The leading edge of the label is applied to the bottle, and the bottle is rolled against a friction pad until the glued trailing edge of the label is adhered to the bottle. The second label station **822** may comprise any type of processing equipment that requires that the bottle be registered between the first and second processing station.

[0098] Those skilled in the art can readily appreciate the various combinations of a first processing station, a registration mechanism, and a second processing station of which the machine **800** is a single embodiment. Alternative embodiments may include any combination of two different or the same label applicators, such as a roll wrapped applicators, applicators for web converted products such as the nip roller style or tamp and blow style, pick and place style applicators, applicators for liner-less labels, burst and place applicators for items separated by perforations or scoring, static charged applicators for adhesive-less application of labels, applicators for labels with ultraviolet cured adhesive, and any other label applicator. Additional embodiments may have one or both processing stations comprise a printing or etching station, such as a laser etching station for etching an image, barcode, or text onto a plastic bottle, a pad printing station, a heat transfer printing machine, an ink jet type printing device, or other direct printing type of station. Further, another embodiment may be the first processing station comprising a glue dispensing station and the second processing station comprising a label applicator that places the label onto the glue.

[0099] Although the number of objects attached to a bottle in the embodiment of **FIG. 8** is two, any desired number of stations, as the device physically allows, can be used. The example of two labels is given only for exemplary purposes and it can be fully appreciated by persons skilled in the art that the same principles and concepts of the invention do encompass designs wherein the number of processing stations can be greater than two.

[0100] **FIG. 9** shows a detail view of **FIG. 8**, showing the application of a first label **902** to bottle **904**. A nip roller **832** rotates in a clockwise direction and spins the bottle **904** in a counter clockwise direction as it applies first label **902** to the bottle **904**. The main star wheel **814** rotates in a counter clockwise direction and contains a plurality of cradles, of which first cradle **908** and **910** are shown. A second label **912** is shown just prior to being applied to bottle **914** at second label station **822**.

[0101] The nip roller **832** is a powered roller that is geared to the rotation of main star wheel **814**. As the bottle **904** advances towards the nip roller **906**, a first label **902** is pinched between the bottle **904** and the nip roller **906**. At this point, known as the nip point, the nip roller's clockwise rotation pulls the remainder of the first label **902** off of the web **916** and presses the first label **902** onto the bottle **904**. The nip roller **832** may be mounted on a compliant mechanism so that it can travel outwardly as the bottle **904** passes underneath the nip roller **906**. Alternatively, the surface of the nip roller **832** that contacts the bottle may be a compliant material, such as a foam rubber that will contact the bottle **904** as it passes underneath.

[0102] The gear ratio of the nip roller **832** to the main star wheel **814** is selected so that the first label **902** is fully applied to the bottle **904**. The gear ratio of nip roller **832** to main star wheel **908** may be further increased or decreased to position the bottle **904** in a specific position before it engages the optional positioning pad **918**. In this manner, the registration of the first label **902** to the second label is adjusted during machine set up and operation. As the speed of the machine increases, the effects of inertia when the bottle is spinning, friction in the cradles, and other elements combine to shift the registration of the first and second labels. By adjusting the gear ratio between the nip roller **832** and the main star wheel **814** as the speed increases, an operator or set up technician can adjust the registration of the two labels. It is common for the nip roller **832** to be controlled with a servo motor which is electronically geared to an input, such as an encoder on the main star wheel **814**. Being electronically geared, the effective gear ratio can be caused to change with different parameters, including speed of the main star wheel **814**.

[0103] An alternative method to a constant speed nip roller **832** is to change the speed of the nip roller **832** during the period that it is engaged with the bottle **904**. For example, the nip roller **832** may begin so that the surface speed of the nip roller is the same as the surface speed of the bottle as it touches the nip point. After the label **902** is nipped between the nip roller **832** and the bottle **904**, the nip roller **832** may be increased in speed to apply the label, and then it may be slowed down to the same speed as at the nip point. This speed profile leaves the bottle **904** in a state where it is not rotating in the cradle **908**, which tends to minimize the inaccuracy of the registration of the first label to the second.

[0104] The cradle **908** has a recess and several rotation wheels **920**. The wheels are designed so that the bottle **904** is free to rotate in the cradle **908** without being scratched or damaged. An alternative design would be to provide a slick, yet non-marring plastic as a cradle material.

[0105] Second label **912** is held to vacuum wheel **828**. As vacuum wheel **828** is rotated in a clockwise direction and main star wheel **814** is rotated in a counter clockwise direction, the bottle **914** and second label **912** will meet. The second label **912** has adhesive applied to leading edge **922** and trailing edge **924** on the face of the second label **912** that faces away from vacuum drum **828**. When the second label **912** comes in contact with bottle **914**, the second label **912** will adhere to bottle **914**. At the same point, bottle **914** will be forced against friction rail **926** and caused to rotate in a counter clockwise direction as it exits the cradle **910**.

[0106] **FIG. 10** illustrates a detail view of the embodiment **800** and similar to **FIG. 9**, except the main star wheel **814** has advanced to the point where the nip roller **832** is disengaging from bottle **904**. Second bottle **914** has just past the nip point for the second label application. The position

of second bottle **914** is such that its first label **1002** is positioned appropriately for the second label **912** to be applied.

[0107] **FIG. 11** shows a detail view of embodiment **800** and similar to **FIGS. 9 and 10**, except the main star wheel **814** has advanced to the point where the first bottle **904** is engaging the optional positioning pad **918**. The optional positioning pad **918** is a fixed mounted fence that grips the surface of the bottle **904** and causes it to spin in a clockwise direction as the main star wheel **814** progresses in a counter clockwise direction. The length of engagement of the positioning pad **918** and the bottle **904** determines how much rotation the bottle **904** will undergo during the process. The material of the positioning pad **918** can be any material that frictionally grips the surface of the bottle **904**, such as a rubber pad.

[0108] The disengagement point **1102** is generally selected to minimize the distance between the disengagement point **1102** and the second label station **822**. This minimizes the period of time that the bottle **904** is unconstrained. The period that the bottle **904** is unconstrained is a contributor to the inaccuracy of the registration of the first label to the second. As the machine runs faster, the effects of inertia and friction of the bottle change the timing of the sequence and often changes the registration of the first label to the second. Correspondingly, the position and length of the optional positioning pad **918** may be optimized for a particular speed that the machine will run.

[0109] Positioning pad **918** may not be required in embodiment **800** if the rotation of nip roller **832** is sufficient to position the bottle **904** in cradle **908** in the proper location so that first label **902** is in the correct position to receive a second label. If the nip roller cannot reorient the bottle **904** to the correct position, an optional positioning pad **918** may be used.

[0110] **FIG. 12** illustrates an embodiment similar embodiment **100** except that the labels are dispensed onto a moving vacuum belt **1202** that serves to both place the label **1204** onto the bottle **1206** and further position the bottle **1206**. The bottle **1206** is carried on main star wheel **1208** in cradle **1210** in a counter clockwise direction. The first label **1202** in this embodiment is a pressure sensitive adhesive backed label transported on a disposable web. The first label **1202** is peeled from the backing **1212** and presented against the vacuum belt **1202**. The vacuum belt **1202** carries the first label **1204** to the nip point **1214** where the first label **1204** is pressed against the bottle **1206**. The bottle **1216** is shown just prior to the point where second label **1218** is about to be placed onto bottle **1216**. The second label **1218** is shown on vacuum wheel **1220**.

[0111] The vacuum belt **1202** is a common method of transport for labels and the like. The construction is belt that has many holes through the surface of the belt. It rides over a track that has openings through which a vacuum is pulled. Lightweight articles with large surface area, such as labels and pieces of paper, are held to the belt as the belt moves.

[0112] The speed of the vacuum belt **1202** is greater than the surface speed of the bottle **1206** and causes the bottle **1206** to rotate counter clockwise, rolling the label **1204** to adhere to the bottle **1206**. The extended length of the vacuum belt **1202** causes the bottle to rotate to a position where it is ready to accept a second label.

[0113] The gear ratio of vacuum belt **1202** to the main star wheel **1208** is selected so that the first label **1204** is fully applied to the bottle **1206** and positions the bottle **1206** in the cradle **1210** to accept a second label. The gear ratio of vacuum belt **1202** to main star wheel **1208** may be further increased or decreased to adjust the position of the bottle **1206** in the cradle. In this manner, the registration of the first label **1204** to the second label is adjusted during machine set up and operation. As the speed of the machine increases, the effects of inertia when the bottle is spinning, friction in the cradles, and other elements combine to shift the registration of the first and second labels. By adjusting the gear ratio between the vacuum belt **1202** and the main star wheel **1208** as the speed increases, an operator or set up technician can adjust the registration of the two labels. It is common for the vacuum belt **1202** to be controlled with a servo motor which is electronically geared to an input, such as an encoder on the main star wheel **1208**. Being electronically geared, the effective gear ratio to change with different parameters, including speed of the main star wheel **1208**.

[0114] An alternative method to a constant gear ratio vacuum belt **1202** is to change the speed of the vacuum belt **1202** during the period that it is engaged with the bottle **1206**. For example, the vacuum belt **1202** may begin so that the surface speed of the vacuum belt **1202** is the same as the surface speed of the web **1212** for the pick up of the label. The speed of the vacuum belt **1202** may be increased to match the surface speed of the bottle **1206** as it touches the nip point **1214**. After the label **1204** is nipped between the vacuum belt **1202** and the bottle **1206**, the vacuum belt **1202** may be increased in speed to apply the label and position the bottle **1206**, and then it may be slowed down to the same speed as at the nip point. This speed profile leaves the bottle **1206** in a state where it is not rotating in the cradle **1210**, which tends to minimize the inaccuracy of the registration of the first label to the second.

[0115] Those skilled in the art of machine design can appreciate that the positioning device may be incorporated into one or more of the processing stations or may be a separate device mounted on the machine. The positioning mechanisms may be stationary, such as a frictional fence, or the positioning mechanisms may be powered devices, such as a moving wheel or belt. Further, the powered devices may incorporate variable speed profiles, sensors, and feedback loops for advanced control. The examples were chosen to best exemplify the invention and those skilled in the art of machine design may find alternative embodiments without deviating from the scope of the invention.

[0116] Further embodiments of the present invention include the assembled bottles with the combinations of labels that heretofore were unproducible.

[0117] **FIG. 13** illustrates a perspective view of an embodiment of an inventive label configuration **1300** of the present invention having two labels applied to a bottle. The bottle **1302** has the first label **1304** underneath the second label **1306**.

[0118] **FIG. 14** illustrates an exploded view of embodiment **1300**. First label **1304** is placed on bottle **1302** and second label **1306** is placed over first label **1304**. Embodiment **1300** maybe, for example, a promotional device wherein first label **1304** is a game piece, ticket, or other premium that is hidden from the consumer. The consumer

must remove the second label **1306** to gain access to the game piece **1304**. The position of second label **1306** with respect to first label **1304** is only critical so that the edges of second label **1306** do not overlap the first label **1304**, if, for example, the second label **1306** were attached by glue only at the edges. The glued edges would interfere with the removal of first label **1304**. If this were to happen, the consumer may have difficulty removing the first label **1304** from the bottle **1302**.

[0119] Embodiment **1300** may, for example, comprise a first label **1304** that is an adhesive backed passive electronic antenna that is covered by second label **1306**. The thickness of first label **1304** may interfere with the gluing or placement mechanism used for second label **1306** and the proper registration of the two labels with respect to each other may be for manufacturing reasons and not necessarily cosmetic or other functional reasons. In these cases, the acceptable placement tolerance may be as large or larger than plus or minus 2 inches or as small as plus or minus 0.001 inches for example.

[0120] Another embodiment **1300** may comprise an active electronic device, such as a battery powered circuit comprising a switch, a speaker, and circuitry to play a sound when the switch is activated. The electronic device may be placed on a bottle and surrounded by a label so that the label completely covers the device. The device may then be activated by pressing the switch through the over wrapping label.

[0121] Another embodiment **1300** may consist of the first label **1304** as a game code printed to the bottle **1302** and the second label **1306** may be placed over the first label **1304** to hide the game code from the player. The number of objects attached to the bottle **1302** in the inventive device is not limited to two. Any number of items may be attached to bottle **1302** which each require registration with respect to each other. The example of two labels is given only for exemplary purposes and it can be fully appreciated by persons skilled in the art that the same principles and concepts of the invention do encompass designs wherein numbers of items greater than two are applied to an object. For example, a bottle may have a game piece attached, a printed code at a second location on the bottle, then a label with graphics overlaying the first two items.

[0122] **FIG. 15** illustrates a perspective view of an embodiment of an inventive label configuration **1500** of the present invention having two labels. The container **1502** has the first label **1504** underneath the second label **1506**, and the second label **1506** has a window **1508** so that the first label **1504** is readily viewable through the second label **1506**.

[0123] **FIG. 16** illustrates an exploded view of embodiment **1500**. First label **1504** is placed onto bottle **1502** and second label **1506** is placed over first label **1504** and registered such that a portion of first label **1504** is viewable through window **1508**.

[0124] The window **1508** may be manufactured by several methods. For a label that is manufactured from a material that is clear, such as a clear plastic film, the window area may be manufactured by selectively not printing any ink across the area defined by the window. Another method, which is applicable to label material that is either opaque or clear, is to die cut and remove the label material in the area of the window. In the case where second label **1506** is printed directly on the bottle, the window **1508** may be created by selectively not printing ink in the area of window **1508**. The window **1508** may be clear, tinted, or selectively tinted through the manufacturing process of the second label **1506**. The size and shape of the window **1508** may be varied widely, including rectangular, circular, or any arbitrary shape.

[0125] The second label **1506** may completely cover the first label **1504** as shown in embodiment **1500**, or may have one or more or all edges of first label **1504** exposed through the window **1508**. The registration of first label **1504** and second label **1506** should be sufficient so that the area of first label **1504** that is designed to be exposed through window **1508** is properly shown through the window **1508**.

[0126] The second label **1506** may entrap the first label **1504** by several methods, regardless of the method of attaching first label **1504**. The second label **1506** may encircle the first label **1504** by purely mechanical means, such as a roll wrapped label which has glue applied to a small strip along edges **1602** and **1604**. An alternative design, applicable to second labels which have a through hole construction for window **1508**, would be to coat the entire inner surface of second label **1506** with adhesive to adhere second label **1506** to bottle **1502**, but also adhere second label **1506** to first label **1504** in the areas of overlap.

[0127] The interaction of the first label **1504** and second label **1506** with respect to the window **1508** takes on many forms. For example, a printed date code may be applied to a container and a label with a window may be positioned so that the date code is visible through the window. Another example would be a game piece or promotion first applied to a bottle, then a second label entraps the game piece with a window through which the game piece is displayed. Further, a first label may be applied which contains bright graphics and a second label with additional graphics applied to a semi transparent film may be applied over the first label as an additional graphic element and to serve as a protective cover to the first label. Another example is the application of a printed color background over which is applied a translucent label with graphics printed in the foreground, giving the visual effect of depth to the label. Further, a second label that is translucent and contains promotional information may be placed over a first label that is the standard label for the product. Another example is the application of a printed game code using a sprayed ink printed which is viewed through a window on a wrap around label, the game code being selectively changed during the production run. Further, a passive electronic device, such as a passive RF identification tag with a date code printed on the outside, may be first placed on the bottle and registered to a window in a label that entraps the tag. Another example has an active electronic device, such as a device with a small battery and a light emitting diode for example, which is placed on the bottle so that a label with a cut out window allows the light emitting diode to show through. Further, the active electronic device may comprise a battery, a switch, a speaker, and circuitry adapted to play an audio recording. The registration tolerance for embodiment **1500** may be as tight as plus or minus 0.001 inches or as loose or looser than plus or minus 2 inches, depending on the construction and design of the components and the assembly method.

[0128] The number of objects attached to the bottle **1502** in the inventive device is not limited to two. Any number of items may be attached to bottle **1502** which each require registration with respect to each other. The example of two labels is given only for exemplary purposes and it can be fully appreciated by persons skilled in the art that the same principles and concepts of the invention do encompass designs wherein numbers of items greater than two are applied to an object. For example, a bottle may have a graphical image printed directly on the bottle, a game piece attached, then a translucent label with graphics overlaying the first graphics and a window through which the game piece is removable.

[0129] **FIG. 17** illustrates a perspective view of an embodiment of inventive label configuration **1700** illustrating a bottle **1702** with a first label **1704** exposed through a window **1708** of second label **1706**. Assembly **1700** illustrates the first label **1704** with one edge exposed through window **1708** and typifies an example where the first label **1704** is a promotional game piece to be opened by a consumer after purchase. An optional perforated or scored line **1710** may be created to aid in the removal of the first label **1704**.

[0130] **FIG. 18** illustrates an exploded view of embodiment **1700**. First label **1704** is assembled to bottle **1702** and second label **1706** is assembled over first label **1704** and registered such that first label **1704** may be viewable through window **1708**.

[0131] The first label **1704** may optionally not have adhesive near the edge **1712** so that the consumer can slide a fingernail under the first label **1704** as they remove the first label **1704**. Further, the first label **1704** may optionally not have adhesive at all between it and bottle **1702**. In this case, first label **1704** may be applied by static charge or other mechanical method until the second label **1706** entraps first label **1704**. The second label **1706** may optionally have any adhesive selectively removed in the overlapping areas between second label **1706** and first label **1704**, which effectively forms a pocket for label **1704**. An alternative embodiment would be to use a shrink-wrap construction for second label **1706**, which would hold first label **1704** and form a pocket. Another example is the first label being a printed game code first applied to a bottle and a second label placed so that the printed game code is beneath the area defined by the perforated line **1710** such that the consumer must remove the perforated area defined by line **1710** to play the game. These embodiments may be useful for applications where first label **1704** is, for example, an instruction booklet that could be removed and replaced several times during the use of the product. The registration tolerance for embodiment **1700** may be as tight as plus or minus 0.001 inches or plus or minus ⅛ inch for example. The tolerance may be larger or smaller based on the application.

[0132] The number of objects attached to the bottle **1702** in the inventive device is not limited to two. Any number of items may be attached to bottle **1702** which each require registration with respect to each other. The example of two labels is given only for exemplary purposes and it can be fully appreciated by persons skilled in the art that the same principles and concepts of the invention do encompass designs wherein numbers of items greater than two are applied to an object. For example, a game code may be printed on a bottle, then a promotional game piece is applied above the printed code, then a label may be wrapped over the game piece with a window through which the game piece can be removed.

[0133] **FIG. 19** illustrates a perspective view of an embodiment of the inventive label configuration **1900** showing a bottle **1902**, a first label **1904**, and a second label **1906**. The first label **1904** is attached to bottle **1902**, and then the second label **1906** is applied starting at the tab area **1908** on first label **1904** and continuing around the bottle **1902** until the other end is attached to tab area **1910**.

[0134] **FIG. 20** illustrates an exploded view of embodiment **1900**. First label **1904** is applied to bottle **1902**, then second label **1906** is applied, covering first label **1904** in tab area **1908** and continuing around bottle **1902** until tab area **1910** is covered.

[0135] **FIG. 21** illustrates a top view of embodiment **1900** shown slightly exploded.

[0136] Embodiment **1900** shows first label **1904** as an instructional booklet and the second label **1906** as a plastic film roll wrap label. Another embodiment may be to have the second label **1906** attach directly to bottle **1902** and with its ends either touching or some distance away from the edges **1912** and **1914**, without overlapping onto first label **1904**. Further, another embodiment may comprise a first label **1904** that is printed directly onto bottle **1902** and a second label **1906** of any construction that is subsequently applied. Another embodiment may be to have the first label **1904** comprise adhesive on the exterior surface in the areas where the second label **1906** overlaps the first label **1904**.

[0137] The number of objects attached to the bottle **1902** in the inventive device is not limited to two. Any number of items may be attached to bottle **1902** which each require registration with respect to each other. The example of two labels is given only for exemplary purposes and it can be fully appreciated by persons skilled in the art that the same principles and concepts of the invention do encompass designs wherein numbers of items greater than two are applied to an object. An embodiment of three items attached to a bottle would be an RF identification tag applied to the bottle with pressure sensitive adhesive, an instructional booklet applied with pressure sensitive adhesive on the position on the opposite side of the bottle from the RF identification tag, and a roll wrapped label that covers the RF identification tag but leaves the instructional booklet exposed.

[0138] **FIG. 22** illustrates a perspective view of an embodiment of the inventive label configuration **2200** showing a bottle **2202**, a first label **2204**, and a second label **2206**. The first label **2204** is attached to bottle **2202**, and then the second label **2206** is placed so that it covers a portion of first label **2202**.

[0139] **FIG. 23** illustrates an exploded view of embodiment **2200**. First label **2204** is assembled to bottle **2202** then second label **2206** is assembled so that a portion of second label **2206** covers all or a portion of first label **2204** and occupies a specific location on top of first label **2204**.

[0140] Embodiment **2200** may have the first label **2204** as a roll wrapped label or other large label with brand identification. The second label **2206** may be a game token,

coupon, or other promotional item, or the second label **2206** may be a second label designed to make the product catch a consumer's eye, such as a hologram, diffraction grating, or other label type. Alternatively, the second label **2206** may be a web converted item, such as a phone card, ticket, game token, or other promotional item that has been attached to a carrier, the carrier being attached directly to first label **2204** and facilitating removal of the promotional item. Further, the second label **2206** may comprise a package for holding a liquid or other items.

[0141] The number of objects attached to the bottle **2202** in the inventive embodiment **2200** is not limited to two. Any number of items may be attached to bottle **2202** which each require registration with respect to each other. The example of two labels is given only for exemplary purposes and it can be fully appreciated by persons skilled in the art that the same principles and concepts of the invention do encompass designs wherein numbers of items greater than two are applied to an object. An embodiment with three items would be to place a roll wrapped label onto a bottle, then place a holographic label onto a specific location on the first label, followed by a promotional game piece onto the first label in a second specific location.

[0142] **FIG. 24** illustrates a perspective view of embodiment of the inventive label configuration **2400** that comprises a bottle **2402**, a first label **2404**, and a second label **2406**. The first label **2404** further comprises two perforated lines **2408** and **2410**. The window **2412** is a hole formed by cutting away and removing material from the second label **2406**.

[0143] **FIG. 25** illustrates an exploded view of embodiment **2400**. First label **2404** is attached to bottle **2402**, then second label **2406** is attached to bottle **2402** such that at least a portion of first label **2404** is viewable through window **2412**.

[0144] In embodiment **2400**, first label **2404** is embodied as a game piece, coupon, phone card, ticket, or other promotional item that is designed for the consumer to remove. For example the promotional item may be a multiply label that contains the perforated lines **2408** and **2410**. The consumer would use a fingernail to peel off the outer ply of the game piece that would separate at perforated lines **2408** and **2410**. Further, first label **2404** may have adhesive selectively applied only under the areas **2414** and **2416** that are outside of the perforated area, better enabling the consumer to remove the center portion of the first label **2404** without damaging the second label **2406**.

[0145] Another embodiment **2400** may comprise a first label **2404** that is a liquid filled packet that has been attached to a paper or other type of backing, the backing being attached to the bottle **2402**. The consumer would then remove the liquid packet portion of first label **2404**.

[0146] The number of objects attached to the bottle **2402** in the inventive embodiment **2400** is not limited to two. Any number of items may be attached to bottle **2402** which each require registration with respect to each other. The example of two labels is given only for exemplary purposes and it can be fully appreciated by persons skilled in the art that the same principles and concepts of the invention do encompass designs wherein numbers of items greater than two are applied to an object. An embodiment with three items could be to place a passive electrical device and a game piece on a bottle, then place an overwrapping label that covers the electrical device, but leaves the game piece exposed through a window in the overlapping label.

[0147] **FIG. 26** illustrates a perspective view of embodiment of the inventive label configuration **2600** that comprises a bottle **2602**, a first label **2604**, and a second label **2606**. Several windows **2608**, **2610**, **2612**, and **2614** are in second label **2606**.

[0148] **FIG. 27** illustrates an exploded view of embodiment **2600**. First label **2604** is attached to bottle **2602**, then second label is attached to bottle **2606**. Embodiment **2600** comprises second label **2606** that is attached by gluing only the overlapping portion of second label **2606** to itself. This results in second label **2606** being free to rotate about the bottle **2602**. Since the second label **2606** is free to rotate about the bottle, the various windows and the first label **2604** can be combined to form a 'secret decoder' type of promotional game. The play of the secret decoder game is to align the windows of the second label **2606** over portions of first label **2604** so that a certain pattern or winning combination is viewable through the windows.

[0149] The number of objects attached to the bottle **2602** in the inventive embodiment **2600** is not limited to two. Any number of items may be attached to bottle **2602** which each require registration with respect to each other. The example of two labels is given only for exemplary purposes and it can be fully appreciated by persons skilled in the art that the same principles and concepts of the invention do encompass designs wherein numbers of items greater than two are applied to an object. An embodiment with three items could be to place a passive electrical device and a game piece on a bottle, then place an overwrapping label that covers the electrical device, but leaves the game piece exposed through the windows in the overlapping label.

[0150] **FIG. 28** illustrates a perspective view of an embodiment of inventive label configuration **2800**, comprising a bottle **2802**, a first label **2804**, and a second label **2806**, wherein first label **2804** is viewable through a cut out **2808** in second label **2806**.

[0151] **FIG. 29** illustrates an exploded view of embodiment **2800**. First label **2804** is placed on bottle **2802** and then second label **2806** is placed onto bottle **2802** such that at least a portion of first label **2804** is viewable through cutout **2808** in second label **2806**. The cutout **2808** is shown as a rectangular cutout. However, the shape of the cutout **2808** can be entirely arbitrary. The window **2808** may be manufactured by several methods. For a label that is manufactured from a material that is clear, such as a clear plastic film, the window area may be manufactured by selectively not printing any ink across the area defined by the window. Another method, which is applicable to label material that is either opaque or clear, is to die cut and remove the label material in the area of the window. In the case where second label **2806** is printed directly on the bottle, the window **2808** may be created by selectively not printing ink in the area of window **2808**. The window **2808** may be clear, tinted, or selectively tinted through the manufacturing process of the second label **2806**. The size and shape of the window **2808** may be varied widely, including rectangular, circular, or any arbitrary shape.

[0152] The embodiment **2800** may comprise a first game piece **2804** that is designed to be removed by the consumer.

Perforations, scoring, or other mechanisms may be employed to ease the removal of first game piece **2804**. Further, first game piece **2804** may be constructed of a multi-ply construction wherein an outer ply is intended to be removed by the consumer, leaving the bottommost ply on the bottle **2802**.

[0153] Embodiment **2800** may comprise a first label **2804** that is constructed of a material such as a diffraction grating that is designed as an eye catching device and is incorporated into the graphics of the second label **2806**. The shape of cutout **2808** may be a graphical element that is then filled in with the diffraction grating of first label **2804**.

[0154] The number of objects attached to the bottle **2802** in the inventive embodiment **2800** is not limited to two. Any number of items may be attached to bottle **2802** which each require registration with respect to each other. The example of two labels is given only for exemplary purposes and it can be fully appreciated by persons skilled in the art that the same principles and concepts of the invention do encompass designs wherein numbers of items greater than two are applied to an object. An embodiment with three items could be to place a diffraction grating and a game piece on a bottle, then place an overwrapping label that covers the game piece, but leaves the diffraction grating exposed through the windows in the overlapping label.

[0155] **FIG. 30** illustrates a perspective view of an embodiment of the inventive label configuration **3000** that comprises a bottle **3002**, a tear strip **3004**, and a label **3006** that comprises optional perforated lines **3008** and **3010**.

[0156] **FIG. 31** illustrates an exploded view of embodiment **3000**. The tear strip **3004** is attached to bottle **3002**, then label **3006** is attached over the tear strip **3004** to bottle **3002**. The embodiment **3000** may be a container for a beverage with a recipe printed on the inside of label **3006**. In order for the consumer to retrieve the recipe, the consumer would grasp the exposed portion of tear strip **3004** and pull downward, tearing the label **3006** at one or both perforated lines **3008** and **3010**.

[0157] Tear strip **3004** may be constructed of a heavy paper or plastic film, or the pull tab **3004** may be constructed of string or wire. The tear strip **3004** may comprise adhesive between the tear strip **3004** and label **3006**, or the label **3006** may comprise adhesive in the overlapping area between label **3006** and tear strip **3004**. The tear strip **3004** may have an exposed tab or may be hidden behind the label **3006**. These examples are not meant to limit the types of labels and of course, those skilled in the arts of promotional items, labels, and the general packaging industry would be able to expand these examples and still fall within the scope of this invention.

[0158] Perforated lines **3008** and **3010** may be actual perforations, scoring, or other mechanical weakening of the label **3006** in the areas of lines **3008** and **3010**. Alternatively, the label **3006** may be constructed of a material that preferentially tears in the direction of the perforations, eliminating the need for the mechanical perforations or scoring. For applications where the entire label **3006** is to be removed by the consumer, only one perforated line **3008** would be needed. For applications where only a portion of label **3006** is to be removed, two perforated lines would be used.

[0159] Embodiment **3000** may be adapted for labels that have coupons reverse printed, meaning printed on the inner side of the label. Further, labels that are designed to cover a specific printed message may be exposed using the tear strip **3004** as part of a promotional campaign.

[0160] The number of objects attached to the bottle **3002** in the inventive embodiment **3000** is not limited to two. Any number of items may be attached to bottle **3002** which each require registration with respect to each other. The example of two labels is given only for exemplary purposes and it can be fully appreciated by persons skilled in the art that the same principles and concepts of the invention do encompass designs wherein numbers of items greater than two are applied to an object. An embodiment with three items could be a game piece attached to a bottle, a tear strip attached to the bottle, and a wrap around label covering both the game piece and the tear strip.

[0161] **FIG. 32** illustrates a perspective view of an embodiment of the inventive label configuration **3200** of the invention comprising a bottle **3202**, a first label **3204**, and a second label **3206** where the second label **3206** is constructed of a translucent plastic film.

[0162] **FIG. 33** illustrates an exploded view of embodiment **3200**. The first label **3204** is attached to bottle **3202** and a second label **3206** is attached to bottle **3202** over first label **3204**.

[0163] Embodiment **3200** is illustrated as a first label **3204** being a standard packaging for the product normally contained in bottle **3202**. Second label **3206** is a special promotional label that highlights a promotion for the product. The graphics on the second label **3206** are coordinated with the graphics on the first label **3204** to enhance the eye catching appeal at the same time keeping the standard graphics for the product.

[0164] Another embodiment **3200** may comprise a second label **3206** as a game whereby the second label must be removed so that the game may be played. Further, another embodiment **3200** may have a second label **3206** as a second graphical element for a standard package for the product.

[0165] Embodiment **3200** may comprise a first label **3204** printed on a material that is not very scratch resistant and a second label **3206** that is considerably more scratch resistant, whereby the second label **3206** provides a scratch resistant cover for the first label **3204**. The second label **3206** may comprise some printed graphical elements on either the obverse or reverse side of the label. Obverse printing is printing on the exterior side of the label and reverse printing is on the interior side of the label. Obverse and reverse printing on a plastic film can give interesting and eye-catching three-dimensional effects to the packaging, which are only intensified when coordinated with the graphics printed on the first label **3204**.

[0166] Another embodiment **3200** may comprise a first label as a holographic image, diffraction grating, reflective media, or other material and the second label is coordinated so that the advertising elements on the first and second labels work with each other.

[0167] The number of objects attached to the bottle **3202** in the inventive embodiment **3200** is not limited to two. Any number of items may be attached to bottle **3202** which each require registration with respect to each other. The example of two labels is given only for exemplary purposes and it can

be fully appreciated by persons skilled in the art that the same principles and concepts of the invention do encompass designs wherein numbers of items greater than two are applied to an object. An embodiment with three items could be a first label with a specific graphical element, a second label with a second construction and a second graphical element, and a third label which serves as a protective cover as well as contributing a graphical element, all three graphical elements are adapted to work together for brand identity.

[0168] **FIG. 34** illustrates a perspective view of an embodiment of the inventive label configuration **3400** of the invention comprising a bottle **3402**, a second container **3404**, and a label **3406** which comprises a window **3408** through which a portion of container **3404** protrudes.

[0169] **FIG. 35** illustrates an exploded view of embodiment **3400**. Container **3404** is attached to bottle **3402**, then label **3406** is placed on the bottle **3404** so that the window **3408** allows all or a portion of container **3404** to protrude through window **3408**.

[0170] Embodiment **3400** may comprise a container **3404** as an injection molded plastic design used in conjunction with the label **3406** in a purely decorative fashion. In this case, the container **3404** may not contain anything at all, but serve only to add texture to the advertisement on the bottle. In another embodiment, the container **3404** may consist of a piece of soft material that protrudes through the window **3408** to give the product a different tactile sensation to the customer.

[0171] The container **3404** may encapsulate or hold a premium, game token, or other promotional item inside the first object **3404**. The consumer would therefore be required to open the container **3404** in order to play the game.

[0172] In another embodiment **3400**, container **3404** may house a second consumable item that goes with the product sold in the bottle **3402**. For example, if the product sold in the bottle **3402** was iced tea, the object **3404** may be a small container of lemon juice. Further, if the bottle **3402** contained paint, object **3404** may contain a catalyst adapted to be mixed into the paint prior to application. Another example is for object **3404** to contain a light oil or lubricant when the bottle **3402** is a container of hardware items. Further, the object **3404** may contain fasteners that are used to install a component sold inside a container **3402**.

[0173] The number of objects attached to the bottle **3402** in the inventive embodiment **3400** is not limited to two. Any number of items may be attached to bottle **3402** which each require registration with respect to each other. The example of two labels is given only for exemplary purposes and it can be fully appreciated by persons skilled in the art that the same principles and concepts of the invention do encompass designs wherein numbers of items greater than two are applied to an object. An embodiment with three items could be a game piece attached to a bottle, a plastic injection molded cover which is placed over the game piece, and an overall label that has the injection molded cover protruding through a window in the overall label.

[0174] The present invention therefore provides an inventive machine that has the unique ability to control the movement of a bottle through an in-line machine in a manner that allows registration between the operations. The operations typified in this specification have been the placement of labels and other decorative elements. However, other operations are envisioned as part of the present invention. For example, the dispensing of glue onto an object at one station and the placement of another object onto the glue would require registration between the glue dispensing and the object placement. Further, multiple printing operations may also require registration between printing operations and may therefore be manufactured on the inventive machine. The mechanisms that control the position of the object in the cradle being processed can vary widely from a stationary friction fence to a servo controlled belt system with varying speed profiles.

[0175] The inventive label configurations comprise at least two different elements that are registered with respect to each other to create unique and useful devices. The placement of specially printed game pieces on a container with a separate display label can take on several forms, including having the game piece being fully or partially hidden from view by the second label. Further, elements that are printed on the container may be registered with respect to other labels and elements that are subsequently applied.

[0176] The inventive packaging configurations comprise the embodiments wherein a first container is applied to a second container and a label is placed or another process performed with respect to the position of the first container. Other embodiments include the case where a label is applied to a first container and a second container is applied to the label, positioned and registered with respect to the label.

[0177] The foregoing description of the invention has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed, and other modifications and variations may be possible in light of the above teachings. The embodiment was chosen and described in order to best explain the principles of the invention and its practical application to thereby enable others skilled in the art to best utilize the invention in various embodiments and various modifications as are suited to the particular use contemplated. It is intended that the appended claims be construed to include other alternative embodiments of the invention except insofar as limited by the prior art.

What is claimed is:

1. A method of applying at least two labels to a substantially cylindrical object with a predetermined angular orientation of said labels about the axis of said cylinder on an in-line labeling machine comprising:

placing said object into a cradle, said cradle allowing said object to freely rotate about said axis, said cradle being mounted to a star wheel comprising a plurality of said cradles;

passing said object past a first labeling machine, said first labeling machine being capable of presenting a first label and applying said first label to said object by rotating said object in said cradle;

positioning said object with a turning mechanism, said turning mechanism having a mechanism that engages said object on the cylindrical surface and changes the rotational orientation of said object to a predetermined orientation; and

presenting said object to a second labeling machine, said second labeling machine being capable of presenting a second label and applying said second label to said object, said second label being in a predetermined angular orientation with respect to said first label.

2. The method of claim 1 wherein said turning mechanism comprises a belt that engages said object, said belt being capable of moving in a speed proportional to the angular speed of said star wheel.

3. The method of claim 2 wherein the speed of said belt is defined by a speed profile, said speed profile being such that the speed of said belt changes during the period of time that said belt is in contact with said bottle, said speed profile being proportional to said speed of said angular speed of said star wheel.

4. The method of claim 1 wherein said turning mechanism comprises a wheel that engages said object, said wheel being capable of moving in a speed proportional to the angular speed of said star wheel.

5. The method of claim 1 wherein said turning mechanism comprises a rigid fence that engages said object and causes said object to rotate a predetermined amount as said star wheel rotates.

6. An in-line machine for applying at least two labels to a substantially cylindrical object with a predetermined angular orientation of said labels about the axis of said cylinder comprising:

a star wheel, said star wheel comprising a plurality of cradles, said cradles allowing said object to freely rotate about said axis;

a first labeling machine, said labeling machine being capable of presenting a first label and applying said first label to said object by rotating said object in said cradle;

a turning mechanism, said turning mechanism having a mechanism that engages said object and changes the rotational orientation of said object to a predetermined orientation; and

a second labeling machine, said labeling machine being capable of presenting a second label and applying said second label to said object, said second label being in a predetermined angular orientation with respect to said first label.

7. The machine of claim 6 wherein said turning mechanism comprises a belt that engages said object, said belt being capable of moving in a speed proportional to the angular speed of said star wheel.

8. The machine of claim 7 wherein the motion of said belt is defined by a motion profile, said motion profile being such that the speed of said belt changes during the period of time that said belt is in contact with said bottle, said motion profile being coupled to the motion of said star wheel.

9. The machine of claim 6 wherein said turning mechanism comprises a wheel that engages said object, said wheel being capable of moving in a speed proportional to the angular speed of said star wheel.

10. The machine of claim 6 wherein said turning mechanism comprises a rigid fence that engages said object and causes said object to rotate a predetermined amount as said star wheel rotates.

11. The machine of claim 6 wherein said turning mechanism is incorporated into said first labeling machine.

12. The machine of claim 9 wherein said turning mechanism is incorporated into said first labeling machine.

13. An object with multiple labels comprising:

an object being substantially cylindrical and having a major axis;

a first label; and

a second label, said second label being placed over at least a portion of said first label, the position of said second label being angularly oriented about said major axis of said object with respect to said first label, wherein said first label and said second label are adhered to said object by different mechanisms.

14. The object of claim 13 wherein said first label is applied by pressure sensitive adhesive and said second claim is applied by hot melt glue.

15. The object of claim 13 wherein said first label is applied by pressure sensitive adhesive and said second claim is applied by cold glue.

16. The object of claim 13 wherein said first label is applied by pressure sensitive adhesive and said second claim is applied by ultraviolet curing adhesive.

17. The object of claim 13 wherein said first label is a promotional game piece.

18. The object of claim 13 wherein said second label comprises a window, said window being positioned such that said first label is viewable through said window.

19. The object of claim 18 further comprising a release mechanism in said second label.

20. The object of claim 19 wherein said release mechanism comprises perforations in said second label.

21. The object of claim 18 wherein said window comprises a cut out portion of said second label.

22. The object of claim 18 wherein said window comprises a transparent portion of said second label.

23. A substantially cylindrical object with at least two labels manufactured on an in-line labeling machine using a process comprising:

placing said object into a cradle, said cradle allowing said object to freely rotate about said axis, said cradle being mounted to a star wheel comprising a plurality of said cradles;

passing said object past a first labeling machine, said first labeling machine being capable of presenting a first label and applying said first label to said object by rotating said object in said cradle;

positioning said object with a turning mechanism, said turning mechanism having a mechanism that engages said object on the cylindrical surface and changes the rotational orientation of said object to a predetermined orientation; and

presenting said object to a second labeling machine, said second labeling machine being capable of presenting a second label and applying said second label to said object, said second label being in a predetermined angular orientation with respect to said first label.

24. The object of claim 23 wherein said turning mechanism comprises a belt that engages said object, said belt being capable of moving in a speed proportional to the angular speed of said star wheel.

25. The object of claim 24 wherein the speed of said belt is defined by a speed profile, said speed profile being such that the speed of said belt changes during the period of time that said belt is in contact with said bottle, said speed profile being proportional to said speed of said angular speed of said star wheel.

26. The object of claim 23 wherein said turning mechanism comprises a wheel that engages said object, said wheel being capable of moving in a speed proportional to the angular speed of said star wheel.

27. The object of claim 23 wherein said turning mechanism comprises a rigid fence that engages said object and causes said object to rotate a predetermined amount as said star wheel rotates.

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